ARRL — Advancing the Art and Science of Radio Since 1914

QST

DEVOTED ENTIRELY TO AMATEUR RADIO

March 2015 WWW.ARRL.ORG

OUR ANNUAL ANTENNA ISSUE

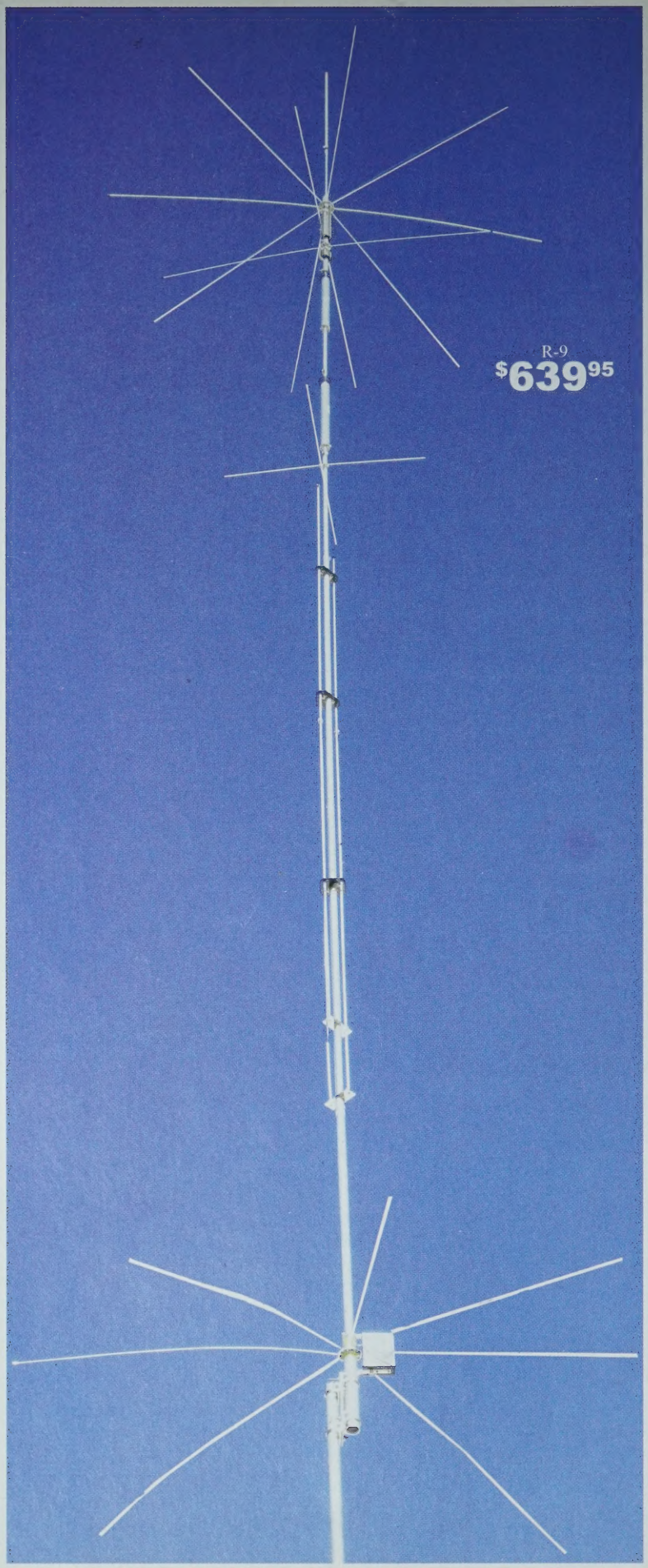
QST reviews:

- **Force 12 XR6**
  Multiband HF Yagi Antenna
- **MFJ-1896**
  6 Meter Moxon Antenna
- **Cubex Mosquito-6**
  70 cm Quad Antenna
- **HobbyPCB Hardrock-50**
  Internal Automatic Antenna Tuner
- **bhi Desktop**
  Amplified DSP Noise Cancelling Speaker

Special Advertising Section
page 129

**********CAR-RT LOT**C-008
0001360499 KI6MZ FO 12/2016
FE2 QST 1 MAR15 0031 #126 #23746
JAMES B HUTCHINSON
2357 ALSCOT AVE
SIMI VALLEY CA 93063-3811

100 Years of QST 1915-2015



Cushcraft

R9

80-6 Meters!

No Radials!

Cushcraft's world famous R8 now has a big brother!

Big Brother R9 now includes 75/80 Meters for local ragchewing and worldwide low band DX *without radials*!

It's omni-directional low angle radiation gives you exciting and easy DX on all 9 bands: 75/80, 40, 30, 20, 17, 15, 12, 10 and 6 Meters with low SWR. QSY instantly -- no antenna tuner needed.

Use full *1500 Watts* SSB/CW when the going gets tough to break through pileups and poor band conditions.

The R9 is super easy to assemble, installs just about anywhere, and its low profile blends inconspicuously into the background in urban and country settings alike.

Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury with all RF-energized surfaces safely out of reach.

Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

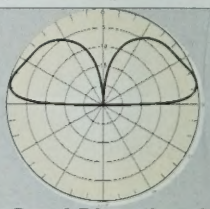
R8, $539.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $79.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $59.95. Three-point guy kit for high winds.

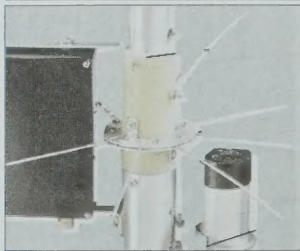
Matching Network

Matching
Broadband matching transformer keeps VSWR low.
Coaxial balun keeps RF off exterior of your coax.
RF Choke DC grounds radiator to prevent static electricity from entering your shack.
High strength, high power, low dielectric PC board material
All Stainless Steel Hardware
Moisture Release vent
SO-239 Feedpoint



Omni-Directional
low angle radiation gives incredible worldwide DX.

Super Rugged Design



Stainless steel machine screws guarantee base integrity.

Dual plate mount makes it easy to install counterpoises.

Heavy duty stainless steel/aluminum interface plate mount keeps your antenna up for years to come.

Free Catalog/Nearest Dealer . . . 662-323-5803
Call your dealer for your best price!

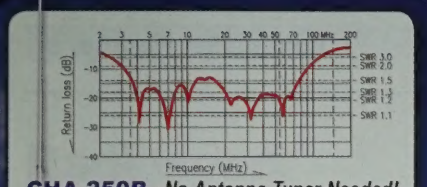
Cushcraft
Amateur Radio Antennas
308 Industrial Pk. Rd., Starkville, MS 39759 • 8-4:30 CST, M-F.
http://www.cushcraftamateur.com

Prices/specifications subject to change without notice/obligation. © Cushcraft®, 2014.

Cushcraft . . . Keeping you in touch around the globe!

C★MET®

Life is a JOURNEY. Enjoy the ride!



CHA-250B - *No Antenna Tuner Needed!*

Base Antennas

❶ C★MET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA
A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

❷ Maldol HVU-8 ULTRA-COMPACT 8 BAND HF/VHF/UHF VERTICAL ANTENNA
80/40/20/15/10/6/2M/70cm Only 1/2 the traditional size and weight of vertical HF antennas, and it includes 2M/70cm! Unique radial system rotates for balcony installations, the radials can all be rotated to one side. • Wavelength: HF and 6M: 1/4 wave • 2M: 1/2 wave • 70cm: Two 5/8 waves in phase • Impedance: 50 Ohm • Max Power: HF 200W SSB • 6M–70cm: 150W FM• Conn: SO-239 • Height: Only 8'6" • Weight: 5lbs. 7ozs.

❸ C★MET GP-3 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Max Pwr: 200W • Length: 5'11"• Weight: 2lbs. 9ozs. • Conn: Gold-plated SO-239 • Construction: Single-piece fiberglass

❹ C★MET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❺ C★MET GP-9 / GP-9N DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
BEST SELLER! • Wavelength: 146MHz 5/8 wave x 3 • 446MHz 5/8 wave x 8 • Max Pwr: 200W• Length: 16' 9"" • Weight: 5lbs. 11ozs. • Conn: GP-9 Gold-plated SO-239 • GP-9N Gold-plated N-type female • Construction: Fiberglass, 3 Sections

❻ C★MET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❼ C★MET GP-15 TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA
Wavelength: 52MHz 5/8 wave • 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 4 • Max Pwr: 150W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated SO-239• 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass

CAA-500
1.8-500MHz SWR/Impedance analyzer
Simple to use and accurate, the CAA-500 displays antenna system SWR and total impedance while turning the thumb wheel to sweep though the selected frequency range.

SO-239 connector for the low range.

N-female provides stable impedance in the high range

Install 6 AA batteries or use the 12VDC jack.

The primary tool for any antenna adjustment, trouble-shooting or installation project!

CAA-5SC
Protect your CAA-500 from moisture, shock, dents and dings!

Shoulder strap included.

Call or visit your local dealer today!
www.natcommgroup.com | 800-962-2611

C★MET®

Our mission: To promote and advance the art, science, and enjoyment of Amateur Radio.

In This Issue

March 2015 Volume 99 Number 3

Harold Kramer, WJ1B
Publisher

Steve Ford, WB8IMY
Editor

Becky R. Schoenfeld, W1BXY
Managing Editor

Larry D. Wolfgang, WR1B
Senior Assistant Technical Editor

Steve Sant Andrea, AG1YK
Assistant Editor

Rick Lindquist, WW1ME
Happenings

Bob Allison, WB1GCM
Product Review Lab Testing

Paul L. Rinaldo, W4RI
Mark J. Wilson, K1RO
Al Brogdon, W1AB
Bernie McClenny, W3UR
H. Ward Silver, NØAX
Paul Wade, W1GHZ
Jon Jones, NØJK
Rick Palm, K1CE
Joel R. Hallas, W1ZR
Barry Shackleford, W6YE
Kai Siwiak, KE4PT
Contributing Editors

Michelle Bloom, WB1ENT
Production Supervisor

Jodi Morin, KA1JPA
Asst Production Supervisor

Maty Weinberg, KB1EIB
Production Coordinator

Sue Fagan, KB1OKW
Graphic Design Supervisor

David Pingree, N1NAS
Senior Technical Illustrator

Jennifer Glifort
Copy Editor

Debra Jahnke, K1DAJ
Business Services Manager
QST Advertising

Bob Inderbitzen, NQ1R
Marketing Manager

Yvette Vinci, KC1AIM
Circulation Manager

Diane Szlachetka, KB1OKV
Advertising Graphics Designer

Steve Ewald, WV1X
Field Organization Supervisor

Gail Iannone
Convention Program Manager

Technical

A Talking Frequency Counter 30
Andrew Woodfield, ZL2PD
An Atmel ATtiny85 microcontroller measures the frequency and synthesizes the voice output in this pocket-sized accessory that's accurate enough for most shack applications.

The DK6ED Double Loop 34
Chris Kunze, DK6ED
Try these pairs of receiving loops for the Top Band.

The WØIH Tunable 80 Meter Dipole 38
Michael Foerster, WØIH
This dipole mechanically tunes over the entire 3.5 to 4 MHz band.

Easy Two-Band Ground Plane for Other Band Combinations 41
Joel R. Hallas, W1ZR
The coupled resonator ground plane antenna can be easily adapted to most band combinations.

An Off Center End Fed Dipole for Portable Operation on 40 to 6 Meters 44
Kai Siwiak, KE4PT
This compact design rolls up and fits in a small DX go-bag for easy travel.

Standing Wave Ratio — What Does It Really Mean? 47
Joel R. Hallas, W1ZR
Higher SWR means more loss, but more loss can mean lower SWR. Here's how to make sense of this.

The Transistor — Or 25 Miles on a Chunk of Germanium 50
George Rose, K2AH
Our series of articles reprinted from vintage issues of *QST* continues, this time with a selection from the March 1953 issue.

Product Review 54
Mark Wilson, K1RO
Force 12 XR6 20 – 6 Meter Yagi Antenna; MFJ-1896 6 Meter Moxon Antenna; Cubex Mosquito-6 70 cm Quad Antenna; HobbyPCB Hardrock-50 Internal Automatic Antenna Tuner; bhi Desktop Amplified DSP Noise Cancelling Speaker.

News and Features

It Seems to Us 9
David Sumner, K1ZZ
Band Planning

Inside HQ 13
Harold Kramer, WJ1B
Volunteer Examiner Coordinator (VEC) Department — Part 1

ARRL Board Holds 2015 Annual Meeting in Connecticut 74
Rick Lindquist, WW1ME
Board fine-tunes DXCC rules and VHF and Above contest rules, lauds departing Director.

Single Operator Portable in the Dry Tortugas 78
Dan Passaro, AK4PX
A 3-day holiday-style operation in rare grid EL84, Garden Key, Florida.

Teaching the Future with Ham Radio 81
Edith Lennon, N2ZRW
Virginia's Chesapeake Public School System introduces Amateur Radio into its electronics classrooms.

ARRL Teachers Institute on Wireless Technology 83
Debra Johnson, K1DMJ
Equipping teachers for the STEM challenge.

Happenings 84
Rick Lindquist, WW1ME
President Craigie reflects upon the ARRL's Centennial year; ARISS news; ARRL Lab receives a new Tektronix oscilloscope; more.

Our Cover
Nathan Marvin, WA1SAZ, is our latest *QST* Centennial Photo Contest winner. This striking nighttime image shows the tower, HF Hex beam, and 6 meter Yagi at his station in Camden, Maine. Marvin is an experienced photographer and notes that the image was the result of a 30-second exposure using a Canon EOS 6D camera and a 15mm Sigma lens set at f6.3.

Radiosport

Contest Corral 89
H. Ward Silver, NØAX

IARU HF Championship 2014 90
Nate Moreschi, N4YDU
Close races, World Radiosport Team Championships, and great conditions — records fell!

Page 44

Page 78

Columns

Correspondence 24
The Doctor is In 64
Eclectic Technology 66
Hands-On Radio 67
Hints & Kinks 72
How's DX? 94
Public Service 87
Technical Correspondence 69
Up Front 20
Vintage Radio 100
The World Above 50 MHz 96
75/50/25 Years Ago 104

Departments

ARRL Member Services 14
ARRL Section Managers 16
ARRL VEC Volunteer Examiner Honor Roll 46
Convention and Hamfest Calendar 102
Feedback 63
Field Organization Reports 104
Ham Ads 162, 163
Index of Advertisers 164, 165
New Products 33, 43
Officers, Division Directors, and Staff 15
QuickStats 146
Silent Keys 105
Special Event Stations 99
Strays 82, 103
W1AW Qualifying Runs 99

Digital and Mobile Editions
ARRL members can access the digital edition via a link at **www.arrl.org/qst**, download our *iOS* app from the iTunes Store, and download our *Android* app from the Google Play Store.

Interested in Writing for *QST*?
www.arrl.org/qst-author-guide
e-mail: **qst@arrl.org**

March 2015
Volume 99 Number 3

QST (ISSN:0033-4812) is published monthly as its official journal by the American Radio Relay League, Inc, 225 Main Street, Newington, CT 06111-1494, USA. Periodicals postage paid at Hartford, CT, USA and at additional mailing offices.

POSTMASTER: Send address changes to: *QST*, 225 Main St, Newington, CT 06111-1494, USA. Canada Post: Publications Mail Agreement #90-0901437. Canada returns to be sent to IMEX Global Solutions, 1501 Morse Ave, Elk Grove Village, IL 60007.

US & Possessions: Membership in the ARRL, including a 1-year subscription to *QST*, is available to individuals at $39. Licensed radio amateurs age 21 and under and the eldest licensee in the household may qualify for the rate of $20. Life Membership, including a subscription to *QST* is available at $975.* Membership includes $15 per year for subscription to *QST*. Membership and *QST* cannot be separated. Libraries and institutions, $39 per year. Single copies $4.99.

International
To compensate for additional postage for mailing outside the US, the following rates apply:

Canada: Membership in the ARRL, including a 1-year subscription to *QST*, $49, payable in US funds. Life Membership, including a subscription to *QST* is available at $1225.* Libraries and institutions, $49 per year.

All Other Countries: Membership in the ARRL, including a 1-year subscription to *QST*, $62, payable in US funds. Life Membership, including a subscription to *QST*, is available at $1550.* Libraries and institutions, $62 per year.

Membership without *QST* is available to the immediate family of a member living at the same address, and to anyone who is legally blind, for $8 per year.

Foreign remittances should be by international postal or express money order or bank draft negotiable in the US and for an equivalent amount in US funds.

Copyright © 2015 by the American Radio Relay League Inc. Title registered at the US Patent Office. International copyright secured. All rights reserved. Quedan reservados todos los derechos. Printed in the USA.

QST®, DXCC®, VUCC®, DX Century Club®, ARES®, Amateur Radio Emergency Service®, and ARRL, the national association for Amateur Radio® are registered trademarks of the American Radio Relay League, Inc.

The ARRL and *QST* in no way warrant the products described or reviewed herein.

QST is available to blind and physically handicapped individuals from the Library of Congress, National Library Service for the Blind and Physically Handicapped. Call 1-800-424-8567 or go to **www.loc.gov/nls/**.

Indexed by Applied Science and Technology Index, Library of Congress Catalog Card No: 21-9421.

*Payment arrangements available. Please write for details.

In order to ensure prompt delivery, we ask that you periodically check the address information on your mailing label. If you find any inaccuracies, please contact the Circulation Department at **circulation@arrl.org** or **860-594-0200** immediately. Thank you for your assistance.

Reprints and permissions: **permission@arrl.org**

Details of our Online Privacy Policy canbe found at **www.arrl.org/online-privacy-policy**.
Telephone: **860-594-0200**
Fax: **860-594-0259**

Don't Rely On Your Transceiver's Built-in Tuner

THINK OUTSIDE THE

It's 5 below zero, the polar vortex is howling, and it's still spitting snow. There's icicles hanging from the gutters, the furnace has been running nonstop for three days, and this morning I had to jump-start my wife's minivan. I couldn't be happier. Winter is DX season; everyone's inside by six, there's no kid soccer to go to, and the grayline comes creeping hours earlier.

The season didn't start off quite so rosy. A few weeks ago I tried to load up my 20 meter dipole, and it just didn't work; the SWR was off the charts. It was never all that low; the dipole's kind of saggy and droops at one end. But I was always able to get my transceiver's built-in tuner to match it. One evening after a big storm I tried to get on the air and the rig's tuner whirred for a while and then just gave up. I fiddled with it for a while, then skated out onto the deck to have a look at the antenna. It was still up, but totally encased in ice! It looked like it was made of glass. All that extra dielectric messed up its impedance, and my rig just couldn't handle it; most built-in tuners are limited to SWRs of 3:1 at most.

I'd been meaning to buy an LDG tuner for quite some time. They're fully automatic, have 2,000 memories, and can match SWRs up to 10:1. Now that I was finally ready to order one, I was afraid I'd waited too long; with the roads iced over I wasn't sure I could get one delivered before the spring thaw. I'm lucky that there's a big ham store about an hour away, and they carry LDG. I called them to ask if they were open, and the guy just laughed. He said he was the only one there, and was closing up and going home. I thanked him and started surfing the internet. Most LDG vendors were estimating a week or more, but I didn't want to wait that long. On a hunch I tried Amazon and low and behold, some LDG products were there, with Prime shipping! I ordered an AT-200ProII, and popped for next-day Saturday delivery.

I felt like a kid waiting for Christmas morning. I tracked the package online, and mostly just sat by the front window waiting for the truck. The plow had been through but it was still snowing and the road was pretty icy; I tried to stay positive. Our dog is our UPS alarm; he knows the sound of the truck and barks when it comes up the street. Around three in the afternoon he started baying, and sure enough there was that big brown beauty, sledding along on chains. I thanked the driver profusely and tipped him a fiver, then tore the package open and installed the tuner. One press of the button and it matched my ice-pole just like that. And if that weren't enough, I got lucky and worked an OH5 in Finland, not exactly rare DX but lots of fun for 100 watts and an icy dipole. I told him we had two feet of snow; he laughed and said they had two meters!

When you decide you need a really capable tuner, better than the one they put in your transceiver, then LDG is the way to go. LDG tuners will match just about anything you can feed with coax, have thousands of memories for instant retuning, and will tune automatically as you operate.

Visit us on the web or contact your favorite dealer!

www.ldgelectronics.com 410-586-2177

BOX WITH LDG ELECTRONICS

ALL TUNERS 2000 MEMORIES

NEW YT-1200

Designed for Yaesu's FT-450, FT-450D, FT-950, FTDX-1200, FTDX-3000 and FT-2000 (non-D). Seamless integration similar to the popular YT-450. The tuner is powered by the transcriber (except the FT-2000). It has a CAT port pass-through so you can use computer control of the transceiver when using this tuner. Power and control through the provided interface cable.

Suggested Price $259.99

Optional M-600 external analog meter $129.99

AT-600ProII

Building on the success of the AT-600Pro, the new AT-600ProII keeps many of the same features of the previous model, but simplifies the operation.With the two-position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before.

Suggested Price $369.99

AT-200ProII

The AT-200ProII now includes LEDs to show antenna position and if the tuner is in bypass. A two position antenna switch stores 2000 memories per switch. Handles up to 250 watts SSB or CW on 1.8 to 30 MHz and 100 watts on 54 MHz. Rugged and easy to read LED bar graphs simultaneously show RF power and SWR.

Suggested Price $259.99

AT-100ProII

Covers all frequencies from 1.8 – 54 MHz (including 6 meters), and will automatically match your antenna in no time. It features a two-position antenna switch with LEDs, allowing you to switch instantly between two antennas. The AT-100ProII requires just 1 watt for operation, but will handle up to 125 watts.

Suggested Price $229.99

KT-100

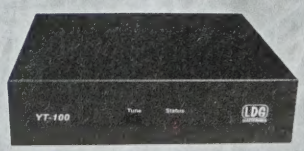
For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 allows you to use the Tune button on the radio. 2,000 memories for instant recall of tuning parameters for favorite bands and frequencies.

Suggested Price $199.99

IT-100

Matched in size to the Icom IC-7000 and IC-706. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible.

Suggested Price $179.99

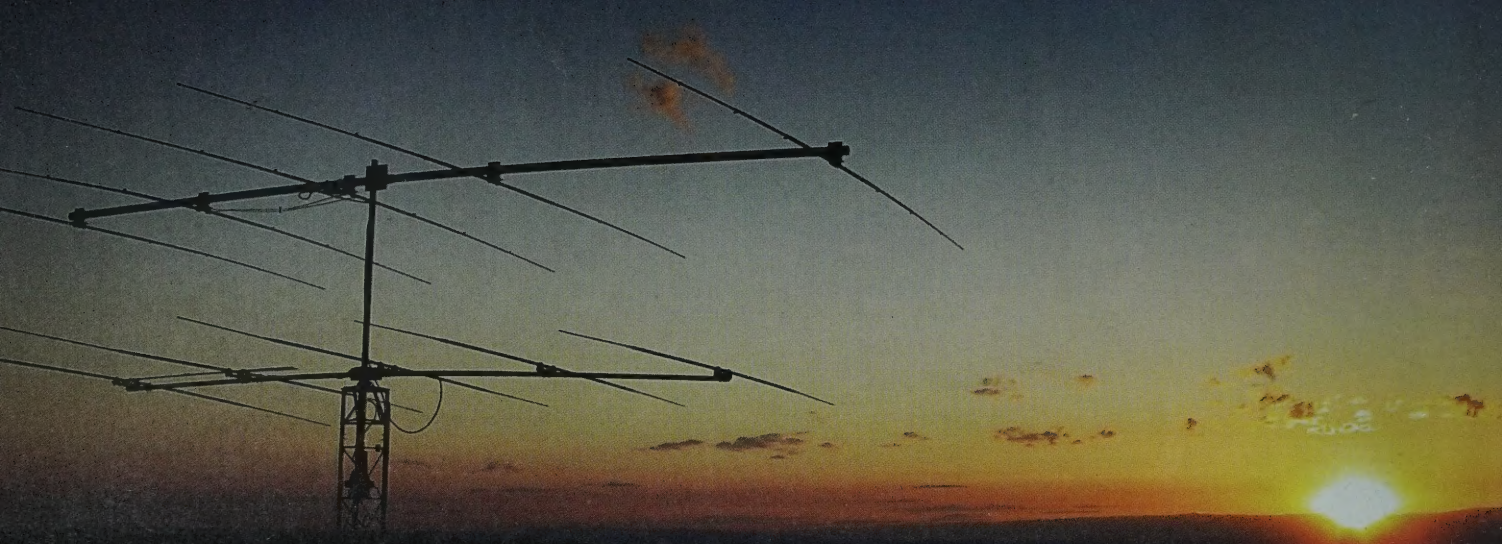


YT-100

For Yaesu FT-857, FT-897 and FT-100 (and all D models) an integrated tuner, powered by the interface. Press the tune button on the tuner, and everything else happens automatically.

Suggested Price $199.99

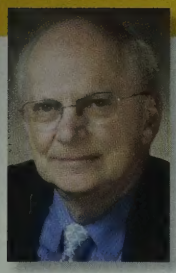
Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!



185 antennas
50 towers
18 stations
15 amplifiers
9 states
2 continents

What are you waiting for?

RemoteHamRadio.com
888-675-8035



David Sumner, K1ZZ — dsumner@arrl.org
ARRL Chief Executive Officer

Band Planning

"The January 2015 Board Meeting marked another step in the process of updating the ARRL HF band plans."

Amateur Radio functions within a framework of international regulations, national laws and regulations, and voluntary standards of good operating practice. As licensees we are obliged to adhere to the regulations of the telecommunications administration that issued the license. In the United States and its territories that is, of course, the Federal Communications Commission; other countries have their own equivalents.

The FCC regulations that govern Amateur Radio are much more detailed than those of most other administrations. Take, for example, the division of the HF bands by mode. With the exception of 60 and 30 meters (160 meters being an MF band) there is in each band an FCC-mandated boundary between the phone/image subband and the RTTY/data subband (the latter generally being referred to as the "CW band" even though CW is permitted in both subbands). In recognition of long-standing amateur practice, the FCC even calls the two subbands of the 3500 – 4000 kHz band by different names: 75 meters for phone/image and 80 meters for RTTY/data.

There are no such divisions in, for example, the Canadian regulations. There is simply a bandwidth limit of 6 kHz in most HF bands, 1 kHz on 30 meters, and 20 kHz on 10 meters. The German regulations are similar with bandwidth limits of 2.7 kHz in most bands, 800 Hz on 30 meters, and 7 kHz on 10 meters. In these two countries, and in most of the rest of the world, there are no subbands established by rule. The administrations leave it to the amateur community to work out how to make the most effective use of the amateur allocations. The mechanism for doing so is called "band planning," and is conducted at both domestic and international levels.

Within the International Amateur Radio Union (IARU), there are three regional organizations corresponding to the Regions that the International Telecommunication Union uses for radio frequency allocation purposes. Each IARU regional organization holds a conference every 3 years at which representatives of IARU member-societies gather to discuss, among other things, regional band plans. Observance of the band plans is voluntary, except in a few countries where the regional IARU band plan is incorporated by reference in the domestic regulations. The regional band planning process is taken quite seriously nonetheless, particularly by the European member-societies. In recent years, there has been a conscious effort to align the regional band plans as much as possible.

Here in the United States we are required to observe the FCC regulations, which dictate somewhat different frequency use than is suggested by the voluntary Region 2 band plans. As most readers of this page know all too well, amending the FCC rules is a very time-consuming and tortuous process. The 3-year cycle of regional band planning may look almost speedy by comparison. Band planning tends to lag changes in operating patterns brought about by the adoption of new technologies, but because the band plans are not mandatory, they are not barriers to progress.

At IARU conferences, the ARRL representatives do not attempt to persuade our colleagues from other countries to bring the regional band plans into perfect alignment with the FCC rules. Such an effort would be both futile and counterproductive. Our domestic band plans therefore depart somewhat from the regional plans, because they must take the constraints of the FCC rules into account.

At its January 2014 meeting, the ARRL Board of Directors acknowledged the concerns of members with regard to the increasing popularity of data modes and asked its HF Band Planning Committee to solicit input as to how the various modes, including CW and RTTY, could better coexist in the RTTY/data subbands. Hundreds of members took the opportunity to share their thoughts. In July the committee reported to the Board that, based on this input, it was preparing "strawman" proposals for updates to the band plans for further membership consideration.

A recurring theme in the comments received was that the FCC had made a mistake in 2006 when it shifted the boundary between the 80 and 75 meter bands from 3750 kHz all the way down to 3600 kHz. On this page in the December 2006 issue of *QST*, we questioned the wisdom of this move, which compressed 250 kHz of CW/RTTY/data activity into just 100 kHz at a time when RTTY/data activity was expanding. A number of commenters said that a readjustment was needed if there was to be any improvement in coexistence among CW/RTTY/data operators on 80 meters. Therefore, the committee advised the Board that it recommended the restoration of 3600 – 3650 kHz for RTTY/data operation, which would require FCC rulemaking.

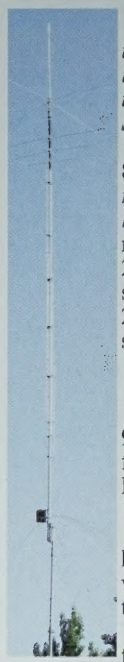
The HF Band Planning Committee submitted a further report to the Board at its January 2015 meeting that outlines its strawman proposals. The committee concluded that apart from the 80 meter issue, most of the concerns voiced by members can be addressed by modest adjustments to the existing band plans, and mainly by confining data modes with bandwidths greater than 500 Hz to the FCC-designated segments for automatically controlled digital stations and to parts of the RTTY/data subbands above those segments. The committee report has more detail and will be available at **www.arrl.org/committee-reports** by the time this issue of *QST* reaches members. The Board is also asking for membership comment on the possibility of adding RTTY and data privileges for Technician and Novice licensees in their existing 15 meter CW subband.

The strawman proposals will be made available in graph form as soon as possible. Member comment is welcomed and encouraged; nothing is set in stone, either with regard to the voluntary band plans or to a possible FCC petition. Take a look and let us know what you think.

David Sumner, K1ZZ

hy-gain Antennas and Rotators

HF Verticals



Work amazing DX with these extremely low radiation angle omnidirectional antennas. All self supporting, 1500 Watts PEP SSB, low SWR. Heavy duty, slotted, tapered, swaged, aircraft quality aluminum tubing. Stainless steel hardware. Two year limited warranty.

AV-680, $549.95. 9 Bands: (6,10,12,15,17,20,30,40, 80 Meters). 26 ft., 18.5 lbs. *Our most popular vertical now has 75/80 Meters! Lets you work exciting DX with a low 17 degree radiation angle!* Easily mount on decks, roofs, patios. *No ground or radials needed.* Extra wide 2:1 SWR bandwidths. *Each* band tunable. Auto bandswitching, handle 1.5kW, 80 MPH wind survival, low 2.5 sq. ft. wind surface. Aircraft aluminum tubing, stainless steel hardware.

AV-640, $449.95. Like AV-680 less 80M. 25½', 17½ lbs.

AV-620, $349.95. Like AV-640 less 40M. 22½'/10½ lbs.

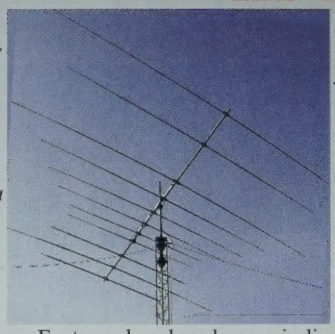
AV-14AVQ, $179.95. (10, 15, 20, 40 Meters). 18 ft., 9 lbs. *Classic* AV-14AVQ uses same trap design as famous Hy-Gain Thunderbird beams. 3 air dielectric Hi-Q traps with oversize coils give superb stability and 1/4 wave resonance on all bands. Automatic bandswitching.

AV-12AVQ, $139.95. (10, 15, 20 Meters). 13 ft., 9 lbs. Lowest priced *automatic bandswitching* tri-band vertical! Uses Thunderbird beam design air dielectric traps for extremely hi-Q performance in limited space.

AV-18VS, $119.95. (10,12,15,17,20,30,40,80M). 18 ft., 4 lbs. Hy-gain's *lowest priced vertical* gives you 8 bands. Easily tuned to any band by adjusting base loading coil.

See our website for even more hy-gain vertical antennas!

HF Beams



Hy-gain beams are *stronger, lighter, have less wind surface and last years longer.* **Why?** *Hy-gain* uses durable *tooled* components -- massive boom-to-mast bracket, heavy gauge element-to-boom clamps, thick-wall swaged tubing -- no failures!

TH-11DX, $1159.95. 11-element, 4.0 kW PEP, 10,12,15,17,20 Meters. *The choice of top DXers.* With 11-elements, excellent gain and 5-bands, the super rugged TH-11DX is the *"Big Daddy"* of all HF beams! Features low loss log-periodic driven array on all bands with monoband reflectors, BN-4000 high power balun, corrosion resistant wire boom support, hot dipped galvanized and stainless steel parts.

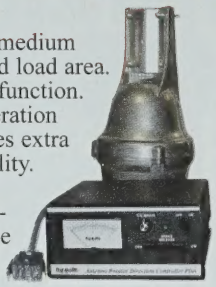
TH-7DX, $869.95. 7-Element, 1.5 kW PEP, 10,15,20 Meters. 7-Elements gives you *the highest average gain of any Hy-gain* tri-bander! Dual driven for broadband operation without compromising gain. SWR less than 2:1 on all bands. Combined monoband and trapped parasitic elements give you an excellent F/B ratio.

TH-3MK4, $469.95. 3-Element, 1.5 kW PEP, 10,15,20 Meters. Gives most gain for your money in full-power, full-size *hy-gain* tri-bander! Impressive gain and a *whopping* average front-to-back ratio and still fits on an average size lot. 95 MPH wind survival.

TH-3JRS, $359.95. Compact 3-Element, 600 W PEP, 10,15,20 Meters. *Hy-gain's most popular and lowest-priced tri-bander fits smallest lot,* 14.75 ft turning radius, 21 lbs. Excellent gain and front-to-back let you compete with the "big guns"! 80 MPH wind survival.

hy-gain Rotators . . . the first choice of hams around the world!

HAM-IV . . . $649.95



The most popular rotator in the world! For medium communications arrays up to 15 square feet wind load area. *New* 5-second brake delay! *New* Test/Calibrate function. *New* low temperature grease permits normal operation down to -30 degrees F. *New* alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *New* indicator potentiometer. *New* ferrite beads reduce RF susceptibility. *New* Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking *steel* wedge brake prevents wind induced antenna movement. North or South center of rotation scale on meter, low voltage control, max mast size of 2 1/16 inches.

HAM-VI, $749.95. For medium arrays up to 15 sq. ft. wind load. Like HAM-IV but has *new* ***DCU-2*** *Digital Rotator Controller.* Just dial in your beam heading or let your computer control your antenna.

HAM-VII, $799.95. Like HAM VI but with ***DCU-3*** digital controller with *six programmable memories.*

Tailtwister T-2X . . . $799.95

For large medium antenna arrays up to 20 sq. ft. wind load. Choose ***DCU-2*** *digital* controller (T-2XD2) or *analog* control box (T-2X) with *new* 5-second brake delay and *new* Test/Calibrate function. Low temperature grease, alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, *new* weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing strength, electric locking *steel* wedge brake, N or S center of rotation scale on meter, low voltage control, 2 1/16" max. mast.

T-2XD2, $899.95. Tailtwister with ***DCU-2*** *digital* controller.

T-2XD3, $949.95. Tailtwister with ***DCU-3*** digital controller with *six programmable memories.*

AR-40, $349.95. For compact antenna arrays and FM/TV up to 3.0 sq. ft. wind load. Dual 12 ball-bearing race. Fully automatic.

CD-45II, $449.95. For antenna arrays up to 8.5 sq. ft. Bell rotator design gives total weather protection. Dual 58 ball bearing race.

Digital Rotator Controller with 6 Programmable beam headings

New!

DCU-3

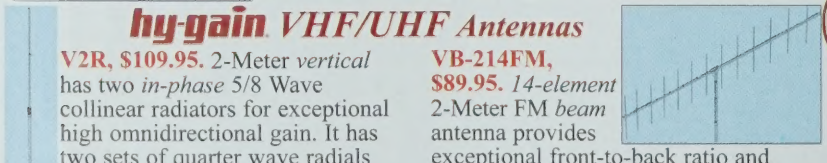
$449.95

New DCU-3 Digital Controller lets you program 6 beam headings! Gives you fully automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Push a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other program) control your DCU-3. Your antenna automatically rotates precisely and safely to your desired direction.

Free Hy-Gain Catalog
and Nearest Dealer . . . 800-973-6572
Call your dealer for your best price!

hy-gain VHF/UHF Antennas



V2R, $109.95. 2-Meter *vertical* has two *in-phase* 5/8 Wave collinear radiators for exceptional high omnidirectional gain. It has two sets of quarter wave radials that decouple radiator from mast. Covers 138-175 MHz. SO-239, handles 500 Watts. 9 feet.

V4R, $109.95. UHF *vertical.* Like V2R but covers 400-475 MHz. Type N, handles 500 Watts, 4 foot.

V42R, $169.95. *Dual band* covers 144/440 MHz bands. Two 5/8 Wave collinears.

VB-214FM, $89.95. *14-element* 2-Meter FM *beam* antenna provides exceptional front-to-back ratio and maximum obtainable gains.

VB-23FM, $49.95. 3-element.

VB-25FM, $59.95. 5-element.

VB-28FM, $79.95. 8-element.

Threaded stub for feedpoints. Accepts up to 2 inch mast.

DB-2345, $89.95. Dual band 144 (3-elements) 440 (5-elements) MHz.

hy-gain®

Antennas, Rotators & Towers

308 Industrial Park Road, Starkville, MS 39759 USA
Toll-free Customer Sales Hotline: 800-973-6572
• **TECH:** 662-323-9538 • **FAX:** 662-323-6551
http://www.hy-gain.com

Prices and specifications subject to change without notice or obligation. ©hy-Gain®, 2013.

Visit http://www.hy-gain.com

DIAMOND ANTENNA

diamondantenna.net

When it comes to quality and performance, DIAMOND ANTENNA is the worldwide leader in VHF/UHF base and mobile antennas.

DIAMOND ANTENNAS help you get the most out of your on-air experience.

For all your base station and repeater needs, DIAMOND has an antenna that will work for you.

You've tried the rest, now own the best!

X700HNA Special Features:

- Heavy duty fiberglass radomes
- Four section assembly
- Overlapping outer shells for added strength
- Stainless steel mounting hardware & radials
- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dualband Base Station/Repeater Antennas				
X700HNA (4 section)	2m/70cm	24	200	N
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

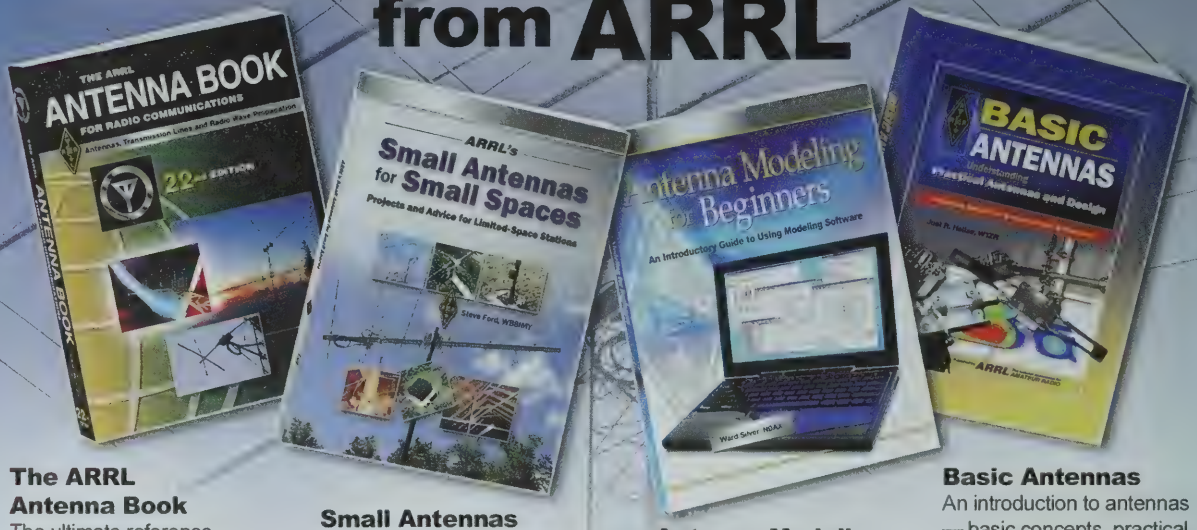
The Standard By Which All Others Are Judged

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

Build 'em Low and Build 'em High!

Shop Antenna Books from ARRL



The ARRL Antenna Book
The ultimate reference for antennas, transmission lines and propagation. Softcover book and CD-ROM.
ARRL Order No. 6948
Only $49.95

Small Antennas for Small Spaces
Find the right antenna design to fit your space. Ideas to get you on the air regardless of where you live!
ARRL Order No. 8393
Only $22.95

Antenna Modeling for Beginners
A guide to using modeling software for designing and evaluating antennas. Provides an introduction to the program EZNEC.
ARRL Order No. 3961
Only $34.95

Basic Antennas
An introduction to antennas — basic concepts, practical designs, and easy-to-build antennas that work!
ARRL Order No. 9994
Only $29.95

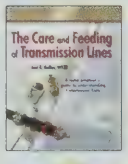
Special Offer!

Save $5 on any ARRL *antenna publication* when you order online by March 15, 2015. Enter Coupon Code WIRE prior to checkout to receive the savings. One coupon per order.

For a complete listing of antenna themed publications visit www.arrl.org/shop

Simple and Fun Antennas
ARRL Order No. 8624
Only $22.95

ON4UN's Low-Band DXing
ARRL Order No. 8560
Only $44.95



The Care and Feeding of Transmission Lines
ARRL Order No. 4784
Only $24.95

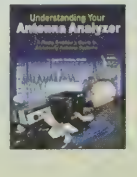
The ARRL Antenna Compendium Volume 8
ARRL Order No. 0991
Only $24.95

The ARRL Guide to Antenna Tuners
ARRL Order No. 0984
Only $22.95

The ARRL Antenna Designer's Notebook
ARRL Order No. 1479
Only $34.95

ARRL's Even More Wire Antenna Classics
ARRL Order No. 0239
Only $19.95

Antenna Towers for Radio Amateurs
ARRL Order No. 0946
Only $34.95



Understanding Your Antenna Analyzer
ARRL Order No. 2889
Only $22.95

ARRL The national association for AMATEUR RADIO®

100 Years of QST *1915-2015*

www.arrl.org/shop

Toll-Free US 888-277-5289,
or elsewhere +1-860-594-0355

Harold Kramer, WJ1B – hkramer@arrl.org, ARRL Chief Operating Officer/*QST* Publisher

Volunteer Examiner Coordinator (VEC) Department — Part 1

Maintaining the integrity of the Amateur Radio Volunteer Exam system is the primary mission of the ARRL Volunteer Examiner Coordinator (VEC) Department. The ARRL VEC began operations 30 years ago when the FCC de-regulated Amateur Radio examinations. It was one of 25 original VECs authorized by the FCC.

Maria Somma, AB1FM, manages the VEC Department. Maria has 29 years of experience with the ARRL VEC and Assistant Manager, Perry Green, WY1O, has almost 15 years. Along with Maria and Perry, the Department has six other employees with an average of over 10 years of experience each. That's a lot of accumulated knowledge and experience. Their goal is for the ARRL VEC to provide the best possible service to our members and the Amateur Radio community.

Volunteer Examiners — Thank You!

Today, the ARRL VEC recruits, certifies, and oversees over 37,000 ARRL Volunteer Examiners in all 50 states and more than 40 countries. If you are a Volunteer Examiner, thank you. The system could not work without you. If you would like to become an ARRL Volunteer Examiner, you must hold at least a General class license and pass an open-book review based on *The ARRL Volunteer Examiner Manual*. The manual is available in print from the ARRL e-store at **www.arrl.org/ve-manual** or a PDF can be viewed or downloaded at **www.arrl.org/become-an-arrl-ve**.

ARRL Volunteer Examiners administered nearly 75% of all FCC Amateur Radio exams in 2014. There were over 7000 exam sessions in 2014 — an all-time record. The ARRL VEC administered about 50,000 separate exam elements — more than 900 a week! While the majority of exams were for Technician licensees, 2014 also saw a 13% increase in license upgrades.

To support these exam sessions, the VEC Department produces and distributes exam materials to the thousands of VE teams in the field. Later this year, we will be implementing a web-based system for distributing exams to VE teams and receiving exam session results from the field. This application is being carefully tested and developed to ensure sensitivity to privacy and security issues, so keep an eye out for it.

Once an exam is received at HQ, the VEC Department carefully checks the exam results and other associated paperwork. If everything is in order, the VEC electronically transmits the information to the FCC and a call sign is issued by the FCC's automated system shortly afterwards. Our service standard is to submit all applications to the FCC within 3 business days. The length of time between submission and license issuance depends on the FCC's work load, the day of the week, and other factors. The new call sign or upgraded license information is then posted in the FCC database on the web at **www.wireless.fcc.gov/uls**.

The ARRL VEC has an authorized, secure connection to the FCC that makes it easy for the VEC to renew our members' licenses, as a free service for ARRL members. The VEC can also change license information, or reinstate an expired license, provided that it is still within the 2-year grace period. It handles tens of thousands of these renewals and changes every year. The easiest way to renew your license is to fill out the ARRL License Renewal Notification form that is sent to every member 4 months before his or her license expires, and return the form to us in the mail. That's the preferred method, but you can also call or e-mail the ARRL VEC (**vec@arrl.org**).

The Question Pool

The ARRL VEC also participates in the creation of the Amateur Radio examination question pool through the Question Pool Committee (QPC). The QPC is part of the National Conference of Volunteer Exam Coordinators (NCVEC), an FCC-mandated organization, whose role is to facilitate communications between the FCC and each VEC (**www.ncvec.org/**). VEC Assistant Manager Perry Green, WY1O, is the ARRL's representative to the QPC. More information is available at **www.ncvec.org/page.php?id=333**.

Creating each question pool is an arduous, year-long process. The question pools are done in a specific order with the Technician class the first year, the General class the next year, and the Amateur Extra class reviewed in the third year. The fourth year is a "rest" year in which no question pool is modified. Element 3, the General Class Question Pool, is now completed and was released to the public on December 15, 2014. It will go into effect July 1, 2015. The ARRL VEC also monitors the question pool during its 4-year life span and modifies the exams when questions are deleted.

Next month, I will discuss the other services that the ARRL VEC performs, particularly those services related to special call signs.

ARRL Member Services

Get Involved
www.arrl.org/get-involved

Join or Renew
www.arrl.org/join

Donate
www.arrl.org/donate

Shop
www.arrl.org/shop

Membership Benefits

Your ARRL membership includes ***QST*** magazine, plus dozens of other services and resources to help you **Get Started**, **Get Involved**, and **Get On the Air**. ARRL members enjoy Amateur Radio to the fullest!

Members-Only Web Services

Create an online ARRL Member Profile, and get access to ARRL members-only web services. Visit **www.arrl.org/myARRL** to register.

- ***QST* Digital Edition – www.arrl.org/qst**
  All members can access the enhanced digital edition of *QST* from a web browser. Apps are available for *iOS* and *Android* devices.
- ***QST* Archive and Periodicals Search – www.arrl.org/qst**
  Browse ARRL's extensive online *QST* archive.
  A searchable index for *QEX* and *NCJ* is also available.
- **Free E-Newsletters**
  Subscribe to a variety of ARRL e-newsletters and e-mail announcements: ham radio news, radio clubs, public service, contesting, and more!
- **Product Review Archive – www.arrl.org/qst**
  Search for and download *QST* Product Reviews published from 1980 to the present.
- **E-Mail Forwarding Service**
  E-mail sent to your **arrl.net** address will be forwarded to any e-mail account you specify.
- **Customized ARRL.org home page**
  Customize your home page to see local ham radio events, clubs, and news.
- **ARRL Member Directory**
  Connect with other ARRL members via a searchable online Member Directory. Share profiles, photos, and more with members who have similar interests.

ARRL Technical Information Service — www.arrl.org/tis

Get answers on a variety of technical and operating topics through ARRL's Technical Information Service. ARRL Lab experts and technical volunteers can help you overcome hurdles and answer all your questions.

ARRL as an Advocate — www.arrl.org/regulatory-advocacy

ARRL supports legislation and regulatory measures that preserve and protect access to Amateur Radio Service frequencies. Members may contact the **ARRL Regulatory Information Branch** for information on FCC rules; problems with antenna, tower and zoning restrictions, and reciprocal licensing procedures for international travelers.

ARRL Group Benefit Programs* — www.arrl.org/benefits

- **ARRL "Special Risk" Ham Radio Equipment Insurance Plan**
  Insurance is available to protect you from loss or damage to your station, antennas, and mobile equipment by lightning, theft, accident, fire, flood, tornado, and other natural disasters.
- **The ARRL Visa Signature® Card**
  Every purchase supports ARRL programs and services.
- **Auto and Home Insurance**
  ARRL members may qualify for special group discounts on home and auto insurance.

* ARRL Group Benefit Programs are offered by third parties through contractual arrangements with ARRL. The programs and coverage are available in the US only. Other restrictions may apply.

Programs

Public Service — www.arrl.org/public-service

Amateur Radio Emergency Service® – **www.arrl.org/ares**
Emergency Communications Training – **www.arrl.org/emcomm-training**

Radiosport

Awards – **www.arrl.org/awards**
Contests – **www.arrl.org/contests**
QSL Service – **www.arrl.org/qsl**
Logbook of The World – **www.arrl.org/lotw**

Community

Radio Clubs (ARRL-affiliated clubs) – **www.arrl.org/clubs**
Hamfests and Conventions – **www.arrl.org/hamfests**
ARRL Field Organization – **www.arrl.org/field-organization**

Licensing, Education, and Training

Find a License Exam Session – **www.arrl.org/exam**
Find a Licensing Class – **www.arrl.org/class**
ARRL Continuing Education Program – **www.arrl.org/courses-training**
Books, Software, and Operating Resources – **www.arrl.org/shop**

Quick Links and Resources

QST – ARRL members' journal – **www.arrl.org/qst**
QEX – *A Forum for Communications Experimenters* – **www.arrl.org/qex**
NCJ – *National Contest Journal* – **www.arrl.org/ncj**
New! ARRL Online Library – **www.arrl.org/library**
Support for Instructors – **www.arrl.org/instructors**
Support for Teachers – **www.arrl.org/teachers**
ARRL Volunteer Examiner Coordinator (ARRL VEC) – **www.arrl.org/vec**
Public and Media Relations – **www.arrl.org/media**
Forms and Media Warehouse – **www.arrl.org/forms**
FCC License Renewal – **www.arrl.org/fcc**
Foundation, Grants, and Scholarships – **www.arrl.org/arrl-foundation**
Advertising – **www.arrl.org/ads**

Interested in Becoming a New Ham?

www.arrl.org/newham · newham@arrl.org · 1-800-326-3942 (US)

Contact Us

ARRL, the national association for Amateur Radio®
225 Main Street, Newington, CT 06111-1494 USA
Tel 1-860-594-0200, Mon-Fri 8 AM to 5 PM ET (except holidays)
FAX 1-860-594-0259, e-mail **hqinfo@arrl.org**
website – **www.arrl.org/contact-arrl**

Facebook
www.facebook.com/ARRL.org

Follow us on Twitter
twitter.com/arrl · twitter.com/w1aw · twitter.com/arrl_pr
twitter.com/arrl_youth · twitter.com/arrl_ares
twitter.com/arrl_dxcc

YouTube
www.youtube.com/ARRLHQ

The American Radio Relay League, Inc.

The American Radio Relay League, Inc. is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communication in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

ARRL is an incorporated association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every three years by the general membership. The officers are elected or appointed by the directors. The League is noncommercial, and no one with a pervasive and continuing conflict of interest is eligible for membership on its Board.

"Of, by, and for the radio amateur," the ARRL numbers within its ranks the vast majority of active amateurs in the nation and has a proud history of achievement as the standard-bearer in amateur affairs.

A *bona fide* interest in Amateur Radio is the only essential qualification of membership; an Amateur Radio license is not a prerequisite, although full voting membership is granted only to licensed amateurs in the US.

Membership inquiries and general correspondence should be addressed to the administrative headquarters: ARRL, 225 Main Street, Newington, Connecticut 06111-1494.

Officers, Division Directors, and Staff

As an ARRL member, you elect the Director and Vice Director who represent your division on ARRL policy matters. If you have a question or comment about ARRL policies, contact your representatives at the addresses shown.

Officers

Founding President (1914-1936)
Hiram Percy Maxim, W1AW

President
Kay C. Craigie, N3KN*
570 Brush Mountain Rd
Blacksburg, VA 24060
540-552-3903; **n3kn@arrl.org**

First Vice President
Rick Roderick, K5UR*
PO Box 1463, Little Rock, AR 72203
501-988-2527; **k5ur@arrl.org**

Second Vice President
Jim Fenstermaker, K9JF
129 Pendleton Way #88
Washougal, WA 98671
206-930-9372; **k9jf@arrl.org**

International Affairs Vice President
Jay Bellows, KØQB
1925 Bidwell St
West St Paul, MN 55118
651-238-4444; **k0qb@arrl.org**

Chief Executive Officer
David Sumner, K1ZZ*

Secretary
David Sumner, K1ZZ

Treasurer
Rick Niswander, K7GM

Chief Financial Officer
Barry J. Shelley, N1VXY

Chief Operating Officer
Harold Kramer, WJ1B

Chief Technology Officer
Brennan Price, N4QX

Staff

General Counsel
Christopher Imlay, W3KD

Business Services Manager
Debra Jahnke, K1DAJ

Development Manager
Lauren Clark, KB1YDD

Education Services Manager
Debra Johnson, K1DMJ

Laboratory Manager
Ed Hare, W1RFI

Marketing Manager
Bob Inderbitzen, NQ1R

Diane Petrilli, KB1RNF
Membership Manager

Yvette Vinci, KC1AIM
Circulation Manager

Media and Public Relations Manager
Sean Kutzko, KX9X

Field Services and Radiosport Manager
Dave Patton, NN1N

Mike Corey, KI1U
Emergency Preparedness Manager

Production & Editorial Manager
Steve Ford, WB8IMY

Regulatory Information Manager
Dan Henderson, N1ND

VEC Manager
Maria Somma, AB1FM

Business Staff

Business Manager
Barry J. Shelley, N1VXY

Controller
Diane Middleton, KC1BQF

Information Technology Manager
Michael Keane, K1MK

*Executive Committee Member

Atlantic Division
www.atldiv.org

Tom Abernethy, W3TOM
PO Box 73, Accokeek, MD 20607
(301-272-0629); **w3tom@arrl.org**

Vice Director: **Robert B. Famiglio K3RF**
PO Box 9, Media, PA 19063
(610-359-7300); **k3rf@arrl.org**

Central Division
www.central.arrl.org

George R. Isely, W9GIG
736 Fellows St, St Charles, IL 60174
(630-584-3510); **w9gig@arrl.org**

Vice Director: **Kermit Carlson, W9XA**
1150 McKee St, Batavia, IL 60510
(630-879-0983); **w9xa@arrl.org**

Dakota Division
www.arrldakota.org

Gregory P. Widin, KØGW
13457 Sixth St N, Stillwater, MN 55082
(651-436-8811); **k0gw@arrl.org**

Vice Director: **Kent R. Olson, KAØLDG**
148 Ironwood Dr, Horace, ND 58047;
(701-298-0956); **ka0ldg@arrl.org**

Delta Division
arrldelta.org

David A. Norris, K5UZ
PO Box 194065, Little Rock, AR 72219-4065;
(870-613-1606); **k5uz@arrl.org**

Vice Director: **Ed B. Hudgens, WB4RHQ**
1441 Wexford Downs Ln, Nashville, TN 37211
(615-333-9859); **wb4rhq@arrl.org**

Great Lakes Division
arrl-greatlakes.org

Dale Williams, WA8EFK*
291 Outer Dr, Dundee, MI 48131
(734-529-3232); **wa8efk@arrl.org**

Vice Director: **Thomas Delaney, W8WTD**
4632 Glenway Ave, Cincinnati, OH 45238
(513-921-7423); **w8wtd@arrl.org**

Hudson Division
www.hudson.arrl.org

Mike Lisenco, N2YBB*
1635 East 46 St, Brooklyn, NY 11234
(917-865-3538); **n2ybb@arrl.org**

Vice Director: **William Hudzik, W2UDT**
111 Preston Dr, Gillette, NJ 07933
(908-580-0493); **w2udt@arrl.org**

Midwest Division
www.arrlmidwest.org

Rod Blocksome, KØDAS
690 Eastview Dr, Robins, IA 52328-9768
(319-393-8022); **k0das@arrl.org**

Vice Director: **Art Zygielbaum, KØAIZ**
6601 Pinecrest Dr, Lincoln, NE 68516
(402-421-0839); **k0aiz@arrl.org**

How to Find an ARRL HQ Staff Member

Can't find the department you're looking for? Call 860-594-0200 or e-mail **hq@arrl.org**. Sending e-mail to any ARRL Headquarters staff member is a snap. Just put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Hiram Maxim, First President of the ARRL, use **w1aw@arrl.org**, or **hmaxim@arrl.org**. If all else fails, send a message to **hq@arrl.org** and it will get routed to the right person or department.

New England Division
www.barc.org/nediv

Tom Frenaye, K1KI*
PO Box J, West Suffield, CT 06093
(860-668-5444); **k1ki@arrl.org**

Vice Director: **Mike Raisbeck, K1TWF**
85 High St, Chelmsford, MA 01824
(978-250-1235); **k1twf@arrl.org**

Northwestern Division
www.nwarrl.wetnet.net

Jim Pace, K7CEX
PO Box 1602, Centralia, WA 98531
(360-508-8437); **k7cex@arrl.org**

Vice Director: **Bonnie Altus, AB7ZQ**
7770 Harmony Rd, Sheridan, OR 97378
(971-237-0711); **ab7zq@arrl.org**

Pacific Division
www.pdarrl.org

Bob Vallio, W6RGG*
18655 Sheffield Rd, Castro Valley, CA 94546
(510-537-6704); **w6rgg@arrl.org**

Vice Director: **Jim Tiemstra, K6JAT**
13450 Skyline Blvd, Oakland, CA 94619;
(510-569-6963); **k6jat@arrl.org**

Roanoke Division
www.arrl-roanoke.org

Dr James Boehner, N2ZZ
525 Barnwell Ave NW, Aiken, SC 29801-3939
(803-641-9140); **n2zz@arrl.org**

Vice Director: **Bill Morine, NØCOP**
101 Windlass Dr, Wilmington, NC 28409
(910-452-1770); **n0cop@arrl.org**

Rocky Mountain Division
www.rockymountaindivision.org

Brian Mileshosky, N5ZGT
PO Box 20186, Albuquerque, NM 87154-0186
(505-463-9468); **n5zgt@arrl.org**

Vice Director: **Dwayne Allen, WY7FD**
PO Box 1482, Sundance, WY 82729-1482
(307-283-3107); **wy7fd@arrl.org**

Southeastern Division
www.southeastern.arrl.org

Doug Rehman, K4AC
34646 Rust Rd, Eustis, FL 32736-2106
(352-600-2960); **k4ac@arrl.org**

Vice Director: **Michael Lee, AA6ML**
PO Box 354645, Palm Coast, FL 32135
(702-494-9066); **aa6ml@arrl.org**

Southwestern Division
www.kkn.net/n6aa

Richard J. Norton, N6AA
21290 West Hillside Dr, Topanga, CA 90290
(310-455-1138); **n6aa@arrl.org**

Vice Director: **Marty Woll, N6VI**
21301 Candice Pl, Chatsworth, CA 91311-1404
(818-773-9655); **n6vi@arrl.org**

West Gulf Division
arrlwgd.org

Dr David Woolweaver, K5RAV*
PO Box 531605, Harlingen, TX 78553
(956-425-3128); **k5rav@arrl.org**

Vice Director: **John Robert Stratton, N5AUS**
PO Box 2232, Austin, TX 78768-2232
(512-282-7851); **n5aus@arrl.org**

*Executive Commitee Member

ARRL Section Managers

www.arrl.org/sections

The 15 divisions of ARRL are arranged into 71 administrative *sections*, each headed by an elected *Section Manager* (SM). Your Section Manager is the person to contact when you have news about your activities, or those of your club. If you need assistance with a local problem, your Section Manager is your first point of contact. He or she can put you in touch with various ARRL volunteers who can help (such as Technical Specialists). Your Section Manager is also the person to see if you'd like to become a section volunteer. Whatever your license class, your SM has an appointment available. Visit your section page on the web at **www.arrl.org/sections/**.

Atlantic Division (DE, EPA, MDC, NNY, SNJ, WNY, WPA)

Delaware: Bill Duveneck, KB3KYH, 18682 Sunny Sky Blvd, Milton, DE 19968-2486 (302-537-4755); **kb3kyh@arrl.org**

Eastern Pennsylvania: Joseph Ames, W3JY, 10 Andrews Rd, Malvern, PA 19355-2941 (610-715-3501); **w3jy@arrl.org**

Maryland-DC: James E. Cross III, WI3N, 16013 Dorset Rd, Laurel, MD 20707-5314 (301-725-6829); **wi3n@arrl.org**

Northern New York: Thomas Dick, KF2GC, 11 Jenkins St, Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**

Southern New Jersey: Thomas J. "Skip" Arey, N2EI, PO Box 236, Beverly, NJ 08010 (609-280-0006); **n2ei@arrl.org**

Western New York: Laura Peters-Mueller, N2LJM, 2011 E Main St, Falconer, NY 14733 (716-338-3122); **n2ljm@arrl.org**

Western Pennsylvania: Tim Duffy, K3LR, 44 Elliot Rd, West Middlesex, PA 16159-2004 (724-866-8877); **k3lr@arrl.org**

Central Division (IL, IN, WI)

Illinois: Tom Ciciora, KA9QPN, 1887 Irene Rd, Sandwich, IL 60548 (815-498-4929); **ka9qpn@arrl.org**

Indiana: Joseph D. Lawrence, K9RFZ, 4624 Willard Dr, Fort Wayne, IN 46815-6759 (260-373-1986); **k9rfz@arrl.org**

Wisconsin: Gary Sorensen, W9ULK, PO Box 212, Oxford, WI 53952 (608-697-2652); **w9ulk@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KSØJ, 1835-63rd St E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**

North Dakota: Lynn A. Nelson, WØND, 6940 4th St SW, Minot, ND 58701 (701-839-8200); **w0nd@arrl.org**

South Dakota: Chris Stallkamp, WØADZ, PO Box 271, Selby, SD 57472-0271 (605-870-1784); **w0adz@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: Dale Temple, W5RXU, 5200 Timber Creek Circle, North Little Rock, AR 72116 (501-771-1111); **w5rxu@arrl.org**

Louisiana: Jim Molan, KD5IGG, 311 N Matthews St, Bunkie, LA 71322-1536 (318-452-5686); **kd5igg@arrl.org**

Mississippi: Malcolm Keown, W5XX, 64 Lake Circle Dr, Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**

Tennessee: Keith E. Miller Sr, N9DGK, 1635 Jarratt Dr, Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Jim Brooks, KY4Z, 7099 Louisville Rd, Cox's Creek, KY 40013 (502-349-2099); **ky4z@arrl.org**

Michigan: Larry Camp, WB8R, 71 Oakdale Lane, Coldwater, MI 49036 (517-278-0406); **wb8r@arrl.org**

Ohio: Scott D. Yonally, N8SY, 258 Valley Hi Dr, Mansfield, OH 44904-9792 (419-512-4445); **n8sy@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: Pete Cecere, N2YJZ, 329 W Saugerties Rd, Woodstock, NY 12498 (845-246-4359); **n2yjz@arrl.org**

NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln, Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**

Northern New Jersey: Richard Krohn, N2SMV, 23 Sweetmans Ln, Manalapan, NJ 07726; **n2smv@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Robert McCaffrey, KØCY, 1210 Noble Hills Pl, Boone, IA 50036 (515-432-2512); **k0cy@arrl.org**

Kansas: Ronald D. Cowan, KBØDTI, PO Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**

Missouri: Dale C. Bagley, KØKY, PO Box 13, Macon, MO 63552-1822 (660-385-3629); **k0ky@arrl.org**

Nebraska: Matthew N. Anderson, KAØBOJ, 2342 Clay St, Ashland, NE 68003 (402-480-5515); **ka0boj@arrl.org**

New England Division (CT, EMA, ME, NH, RI, VT, WMA)

Connecticut: Betsey Doane, K1EIC, 92 Mohegan Rd, Shelton, CT 06484-2448 (203-929-7759); **k1eic@arrl.org**

Eastern Massachusetts: Tom Walsh, K1TW, 9 Wildwood Dr, Bedford, MA 01730 (781-275-5882); **k1tw@arrl.org**

Maine: Bill Crowley, K1NIT, 150 Maple St, Farmingdale, ME 04344-4809 (207-623-9075); **k1nit@arrl.org**

New Hampshire: Peter Stohrer, K1PJS, 9 Gladstone St, Concord, NH 03301; **k1pjs@arrl.org**

Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd, Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**

Vermont: Paul N. Gayet, AA1SU, 11 Cherry St, Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**

Western Massachusetts: Ed Emco, W1KT, 37 Bullard Ave, Worcester, MA 01605 (508-853-3333); **w1kt@arrl.org**

Northwestern Division (AK, EWA, ID, MT, OR, WWA)

Alaska: Jim Larsen, AL7FS, 3445 Spinnaker Dr, Anchorage, AK 99516-3424 (907-345-3190); **al7fs@arrl.org**

Eastern Washington: Mark Tharp, KB7HDX, PO Box 2222, Yakima, WA 98907-2222 (509-965-3379); **kb7hdx@arrl.org**

Idaho: Edward Stuckey, AI7H, 2300 W Polo Green Ave, Post Falls, ID 83854-9680 (208-457-0354); **ai7h@arrl.org**

Montana: George Forsyth, AA7GS, 212 Skyline Dr NE, Great Falls, MT 59404 (406-868-2212); **aa7gs@arrl.org**

Oregon: Everett Curry, W6ABM, 1546 NE Greensword Dr, Hillsboro, OR 97124-6139 (503-522-7142); **w6abm@arrl.org**

Western Washington: Monte L. Simpson, W7MLS, PO Box 5835, Bremerton, WA 98312 (360-373-3095); **w7mls@arrl.org**

Pacific Division (EB, NV, PAC, SV, SF, SJV, SCV)

East Bay: James Latham, AF6AQ, 1798 Warsaw Ave, Livermore, CA 94550-6140; (925-447-6136); **af6aq@arrl.org**

Nevada: Gary Grant, K7VY, 11040 Broken Hill Rd, Reno, NV 89511 (775-851-7840); **k7vy@arrl.org**

Pacific: Bob Schneider, AH6J, PO Box 131, Keaau, HI 96749-0131 (808-966-8146); **ah6j@arrl.org**

Sacramento Valley: Ronald D. Murdock, W6KJ, 998 Bogue Rd, Yuba City, CA 95991-9221 (530-674-8533); **w6kj@arrl.org**

San Francisco: Bill Hillendahl, KH6GJV, PO Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**

San Joaquin Valley: Dan Pruitt, AE6SX, 4834 N Diana St, Fresno, CA 93726 (559-779-2974); **ae6sx@arrl.org**

Santa Clara Valley: Brandon Bianchi, NI6C, 22479 Ferdinand Dr, Salinas, CA 93908 (559-313-3373); **ni6c@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: Karl Bowman, W4CHX, 5509 Shimer Farm Ln, Raleigh, NC 27614-6301 (919-669-6068); **w4chx@arrl.org**

South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 (803-327-4978); **n4ufp@arrl.org**

Virginia: Carl Clements, W4CAC, 4500 Wake Forest Rd, Portsmouth, VA 23703 (757-484-0569); **w4cac@arrl.org**

West Virginia: Charles L. Hardy Jr, WV8CH, 1203 Bachman Rd, Fayetteville, WV 25840 (304-640-4630); **wv8ch@arrl.org**

Rocky Mountain Division (CO, NM, UT, WY)

Colorado: Jack Ciaccia, WMØG, PO Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**

New Mexico: Bill Kauffman, W5YEJ, 1625 36th St SE, Rio Rancho, NM 87124-1719 (505-349-0460); **w5yej@arrl.org**

Utah: Mel Parkes, NM7P, 2166 E 2100 North, Layton, UT 84040 (801-547-1753); **nm7p@arrl.org**

Wyoming: Garth Crowe, WY7GC, 1206 Avalon Ct, Gillette, WY 82716-5202 (307-686-9165); **wy7gc@arrl.org**

Southeastern Division (AL, GA, NFL, PR, SFL, VI, WCF)

Alabama: David Drummond, W4MD, 5001 Lakehurst Dr, Northport, AL 35473 (205-339-7915); **w4md@arrl.org**

Georgia: Gene Clark, W4AYK, 1604 Lynwood Lane, Albany, GA 31707 (229-888-1090); **w4ayk@arrl.org**

Northern Florida: Steve Szabo, WB4OMM, 536 Central Park Blvd, Port Orange, FL 32127-1136 (386-566-2085); **wb4omm@arrl.org**

Puerto Rico: Rene Fonseca, NP3O, HC 67 Box 15593, Fajardo, PR 00738 (939-579-4134); **np3o@arrl.org**

Southern Florida: Jeff Beals, WA4AW, PO Box 1584, Loxahatchee, FL 33470-1584 (561-252-6707); **wa4aw@arrl.org**

Virgin Islands: Fred Kleber, K9VV, PO Box 24275, Christiansted, VI 00824-0275; **k9vv@arrl.org**

West Central Florida: Darrell Davis, KT4WX, 6350 Mills Rd, Fort Meade, FL 33841 (863-245-9923); **kt4wx@arrl.org**

Southwestern Division (AZ, LAX, ORG, SDG, SB)

Arizona: Robert J. Spencer, KE8DM, 1831 S McKinley Ave, Yuma, AZ 85364-5114 (928-941-7069); **ke8dm@arrl.org**

Los Angeles: David Greenhut, N6HD, 5260 Darro Rd, Woodland Hills, CA 91364-1933 (818-992-5507); **n6hd@arrl.org**

Orange: Carl Gardenias, WU6D, 20902 Gardenias St, Perris, CA 92570 (951-490-2270); **wu6d@arrl.org**

San Diego: Stephen M. Early, AD6VI, 4724 Maple Ave, La Mesa, CA 91941 (619-461-2818); **ad6vi@arrl.org**

Santa Barbara: Robert Griffin, K6YR, 1436 Johnson Ave, San Luis Obispo, CA 93401-3734 (805-801-7292); **k6yr@arrl.org**

West Gulf Division (NTX, OK, STX, WTX)

North Texas: Chris Brewer, N5GMJ, 8308 N Water Tower Rd, Saginaw, TX 76179-5169 (817-939-3128); **n5gmj@arrl.org**

Oklahoma: Lloyd Colston, KC5FM, 813 Canterbury Blvd, Altus, OK 73521-4903 (234-564-2775); **kc5fm@arrl.org**

South Texas: Lee H. Cooper, W5LHC, 2507 Autrey Dr, Leander, TX 78641 (512-260-7757); **w5lhc@arrl.org**

West Texas: Bill Roberts, W5NPR, 34 Sunny Glen, Alpine, TX 79830 (432-837-2741); **w5npr@arrl.org**

AMERITRON . . . 800 Watts . . . $999!

More hams use Ameritron AL-811/H amplifiers than any other amplifier in the world!

AL-811H
$999
Suggested Retail
4-Tubes, 800 Watts

AL-811
$849
Suggested Retail
3-Tubes, 600 Watts

Only the Ameritron AL-811H gives you four *fully neutralized* 811A transmitting tubes. You get absolute stability and superb performance on higher bands that can't be matched by un-neutralized tubes.

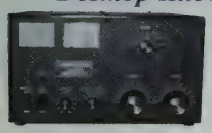
You get a quiet desktop linear that's so compact it'll slide right into your operating position -- you'll hardly know it's there . . . until QRM sets in. And you can conveniently plug it into your nearest 120 VAC outlet -- no special wiring needed.

You get all HF band coverage (with license) -- including WARC and most MARS bands at 100% rated output. Ameritron's *Adapt-A-Volt*™ hi-silicon core power transformer has a special buck-boost winding that lets you compensate for high/low power line voltages.

You also get efficient full size heavy duty tank coils, slug tuned input coils, operate/standby switch, transmit LED, ALC, dual illuminated meters, QSK with optional QSK-5, pressurized cooling that you can hardly hear, full height computer grade filter capacitors and more. 13¾Wx8Hx16D inches.

AL-811, $849. Like AL-811H, but has three 811A tubes and 600 Watts output.

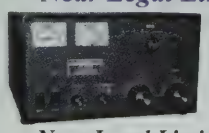
Desktop Kilowatt **Amplifier**



AL-80B
$1595
Suggested Retail

Whisper quiet *desktop* amp plugs into 120 VAC to give *full* kilowatt SSB PEP output. Ameritron's exclusive *DynamicALC*™ doubles average SSB power out and *Instantaneous RF Bias*™ gives cooler operation. All HF bands. 850 Watts CW out, 500 Watts RTTY out, extra heavy duty power supply, 3-500G tube, 70% efficiency, tuned input, Pi/Pi-L output, inrush current protection, dual Cross-Needle meters, QSK compatible, 48 lbs. 14Wx8½Hx15½D in. **Two-year warranty.**

Near Legal Limit ™ **Amplifier**



AL-572
$1895
Suggested Retail

Near Legal Limit™ amplifier gives you 1300 Watt PEP SSB power output for *60%* of price of a full legal limit amp! 4 rugged 572B tubes. Instant 3-second warm-up, plugs into 120 VAC. Compact 14½Wx 8½Hx15½D inches fits on desktop. 160-15 Meters. 1000 Watt CW output. Tuned input, instantaneous RF Bias, dynamic ALC, parasitic killer, inrush protection, two lighted cross-needle meters, multi-voltage transformer.

Amplifiers with *3CX800A7 tube*

Suggested Retail
AL-800F
$1995
1 tube, 1250 Watts
AL-800HF
$2745
2 tubes,
1.5 kW *Plus*
AL-800, $2295
AL-800H, $3345
with *Eimac*(R) tubes

These *compact* desktop amplifiers with 3CX800A7 tubes cover 160-15 Meters including WARC bands. Adjustable slug tuned input circuit, grid protection, front panel ALC control, vernier reduction drives, heavy duty 32 lb. silicone steel core transformer, high capacitance computer grade filter capacitors. Multi-voltage operation, dual lighted cross-needle meters. 14¼Wx8½Hx16½D in.

True Legal Limit™ **Antenna Tuner**

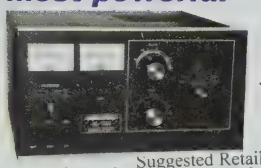
ATR-30
$599.95
Suggested Retail

Easily handles 1500 Watts continuous carrier even on 160 Meters. High-current edge-wound silver plated roller inductor, two 500 pF high capacitance tuning capacitors and a 3-core choke balun can handle the world's most powerful amps -- like AL-1500! Has a six position antenna switch, *true* peak reading Cross-Needle SWR/Wattmeter, 6:1 vernier reduction drives, more! 13¼Wx5⅝Hx17½D". **ATR-20, $459.95.** For AL-80B, AL-811/H.

AMERITRON *full legal limit* **amplifiers**

AMERITRON legal limit amps use a super heavy duty Hypersil*(R) *power transformer capable of 2.5 kW!

Most powerful -- 3CX1500/8877



AL-1500F
$3395
3CX1500/8877 Tube
AL-1500
$4195
Eimac(R) tube
Suggested Retail

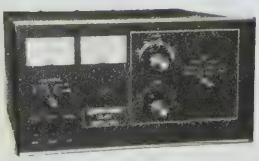
Ameritron's *most powerful* amplifier uses the herculean 3CX1500/8877 ceramic tube. 65 watts drive gives you full legal output -- it's just loafing with a 2500 Watts power supply.

Toughest -- 3CX1200Z7

AL-1200
$3995
Suggested Retail

Get ham radio's *toughest* tube with the Ameritron AL-1200 -- the *Eimac*(R) 3CX1200Z7. It has a 50 Watt control grid dissipation. What makes the Ameritron AL-1200 stand out from other legal limit amplifiers? The answer: A super heavy duty power supply that loafs at full legal power -- it can deliver the power of more than 2500 Watts PEP two tone output for a half hour.

Classic -- Dual 3-500Gs



AL-82
$2995
Suggested Retail

This linear gives you full legal output using a *pair* of *genuine* 3-500Gs. Competing linears using 3-500Gs *can't* give you 1500 Watts because their lightweight power supplies *can't* use these tubes to their full potential.

Ameritron brings you the finest high power accessories!

ARB-704 amp-to-rig interface. . . $59.95

Protects rig from damage by keying line transients and makes hook-up to your rig easy!

RCS-4 Remote Coax Switch. . . $159.95

Use 1 coax for **4** antennas. No control cable needed. SWR <1.25, 1.5 - 60 MHz. Useable to 100 MHz.

RCS-8V Remote Coax Switch. . . $169.95

Replace **5** coax with 1! 1.2 SWR at 250 MHz. Useable to 450 MHz. < .1 dB loss, 1kW@ 150MHz.

RCS-10 Remote Coax Switch. . . $179.95

Replace **8** coax with 1! SWR<1.3 to 60 MHz. **RCS- 10L, $219.95** w/lightning arrestors.

SDC-104 (I,K,Y) Auto Screwdriver Antenna Controller . . . $159.95

Receives frequency data from your rig and automatically tunes your screwdriver antenna.

ADL-1500 Dummy Load with oil . . . $74.95

Oil-cooled. 50 Ohms. 1500 Watts/5 minutes. SWR< 1.2 to 30 MHz. Low SWR to 400 MHz.

ADL-2500 fan-cooled Dry Dummy Load, $219.95

Whisper quiet fan, 2.5kW/1 minute on, ten off. 300W continuous. SWR< 1.25 to 30 MHz.<1.4 to 60 MHz.

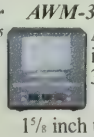
ATP-100 Tuning Pulser . . . $69.95

Safely tune up for full power, best linearity. Prevents overheating, tube damage, power supply stress, component failure.

ICP-120 Inrush Current Protector

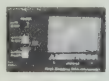
Ameritron's *Step-Start Inrush Current Protector*™ **. . . $79.95** stops damaging inrush current. Momentary high-voltage "spikes" in the AC line can cause damage to your amp. ICP-120 has built-in varistors to absorb these spikes. Works with nearly all linear amplifiers.120V. **ICP-240, $79.95.** For 240V.

AWM-30B Precision SWR/Wattmeter . . . $149.95



Active circuit gives *true* peak/average readings on lighted Cross-Needle meter. 3000/300 Watt ranges. Remote sensor.

Flat Mobile SWR/Wattmeter . . . $159.95



1⅝ inch thick, flat mounts on dashboard. Remote sensor, 25 ft. thin cable. True peak reading. Cross-needle, lighted. 1.5 kW, 1.8-30 MHz. *High-SWR* LED.

Call your dealer for your best price!

Free Catalog: 800-647-1800

AMERITRON®

. . . the world's high power leader!

116 Willow Road, Starkville, MS 39759
TECH (662) 323-8211 • **FAX** (662) 323-6551
8 a.m. - 4:30 p.m. CST Monday - Friday

For power amplifier components call (662) 323-8211

Prices and specifications subject to change without notice. ©2014 Ameritron

www.ameritron.com

Array Solutions Your Antenna System Solutions Company

FT5ZM AMSTERDAM ISLAND 2014 DXPEDITION

Professional Grade Equipment from Array Solutions

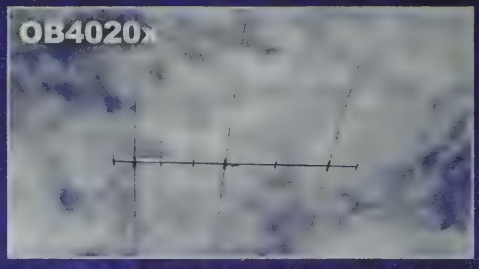
OPTIBEAM

Absolutely Unique Shortwave Antennas from OptiBeam

OB8040-3D

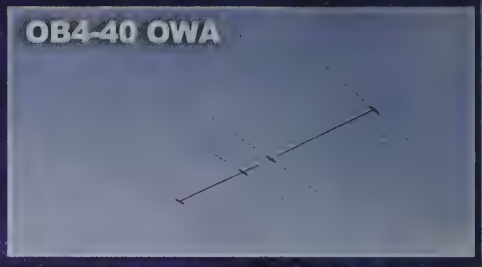
Big triband Yagi for the low bands 80-40-30m
8 high Q coil shortened elements, 40 foot boom
2el 80m / 3el 40m / 3el 30m / 1 feed line

OB4020-5



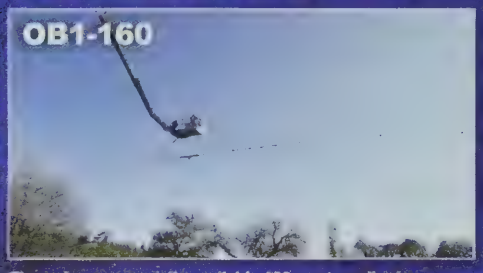
Really big duo band Yagi 40-20m for highest demands
8 elements on a 50 foot boom / extra heavy duty design
3el full sized 40m / 5el full sized 20m / 2 feed lines

OB4-40 OWA



The biggest commercially available 40m OWA Yagi
4 elements on a 50 foot boom / extra heavy duty design
Highest gain / best pattern / perfect 300 khz full coverage

OB1-160

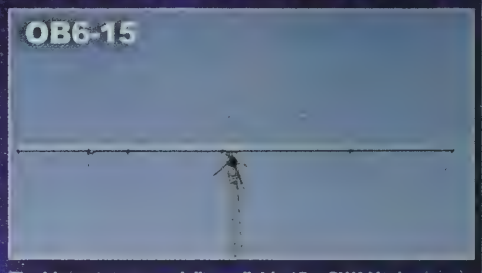


The only commercially available 160m rotary dipole
High Q coil plus end loading shortened element
Element length 112 feet / extra heavy duty design

OB21-3

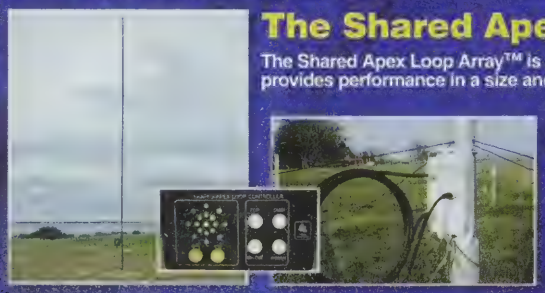
The highest performing 20-15-10m triband Yagi world wide
21 full sized elements on a 47 foot boom / heavy duty design
5el 20m / 5el 15m / 11el 10m / 1 feed line

OB6-15



The biggest commercially available 15m OWA Yagi
6 elements on a 50 foot boom / extra heavy duty design
Also available as OB7-10 / 7el OWA for 10m / 50 foot boom

The Shared Apex Loop Array™!

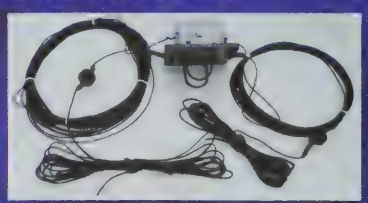


The Shared Apex Loop Array™ is a revolutionary receiving antenna that will change the way that you listen to the radio! The patented design provides performance in a size and over a range of frequencies that will please both the rag-chewer and DXer alike.

Three models to chose from:
- AS-SAL-30 - optimized for VLF, BCB, 160/80/40m.
- AS-SAL-20 - optimized for BCB, and 1.8-30MHz.
- A-SAL-12 - optimized for 3-30MHz.

Array Solutions OCF 80-6m Dipoles

Built to Military Standards just like the rest of our commercial products!



K9AY Loop Antenna

The AYL-4 K9AY Loop System requires approximately 18 feet in four directions from the center of the antenna, plus additional distance depending on the guying method. The base of the supporting pole and the ground rod are located at the center. With the AYL-WM kit, 18 feet in each of the four directions is required.

Array Solutions Antenna Switches, Phasing Systems, and Test Equipment

Stacking and Phasing Systems

- StackMatch 3 antennas
- StackMatch II 2 antenna
- StackMaster 4 antennas+
- 2 element and 4 Squares

Antenna Switches

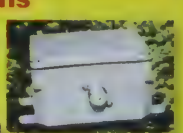
- 1X2 Two Paks
- 1X6 RatPak
- 2X6 SixPak
- 2X8 EightPak
- 4X8 EightPak

Test Equipment

AIM UHF 5 kHz to 1 GHz Vector Impedance Analyzer

New Premium Baluns

- The new benchmark for baluns 10k ohms reactance
- Ruggedized metal cases
- 1:1 up to 16:1 3 kW to 10 kW



NEW!

www.arraysolutions.com
2611 North Beltline Rd., Suite 109
Sunnyvale, Texas 75182 USA
sales@arraysolutions.com
Phone 214-954-7140 Fax 214-954-7142

Attached are QR codes for A5 and O6. Download a QR code reader application on your tablets or smartphones and try it.

Array Solutions products are in use at top DX and Contest stations worldwide as well as commercial and government agencies. We provide RF consulting to the DoD, FEMA, Embassies, UN, WHO, FAA and the State Dept. for products and installation of antennas systems, antenna selection, filtering, switching and grounding. We also offer RF engineering and PE consulting services.

www.arraysolutions.com www.optibeam.de

The Radio At Both Ends Of The QSO

ELECRAFT
K3

"The outstanding receiver and transmitter characteristics allowed us to run two positions simultaneously on any band – even the very narrow 30 meter band – with absolutely no interference. Good design makes the complex appear simple: the ins and outs of this sophisticated radio were quickly mastered by the operator team."

Ralph Fedor - K0IR

The Elecraft K3 is the DXer's choice — at home, or at the ends of the Earth.

What do DXpedition leaders look for in a transceiver? Top performance in pileups, for starters, including a bulletproof, software-defined superhet receiver that can turn raw QRM into solid QSOs. But team leaders are also pragmatic; they need radios that won't break their backs or their budgets. That's why the K3 and other Elecraft K-Line gear has been selected for so many exciting, high-profile DXpeditions*. The K3 offers proven field reliability, light weight, excellent power efficiency and ease of use, all at a fraction of the price of other elite-class transceivers. It also has the ultra-low-phase-noise, click-free transmit signal that multi-transmitter stations need.

What do you look for in a transceiver? Probably all of the above. Sure, you may decide not to circumnavigate the world. But with the right rig, you can still conquer it.

Elecraft's K-Line – a winning combination for contesters and DXers alike.

In addition to the K3, Elecraft's K-Line includes the P3 panadapter, KPA500 500 W+ amplifier, and KAT500 500 W+ automatic antenna tuner. All three can be used with the K3 or with other transceivers. The P3 panadapter adds a visual dimension to signal hunting, with fast, real-time spectrum and waterfall displays of band activity. Its superior sensitivity reveals signals down to the K3's noise floor. The KPA500 amp features instant RF-based band switching, plus remote band selection that tracks the K3. It has bright alphanumeric status display and LED bar graphs, and a rugged, internal linear supply. The compact KAT500 ATU uses the same fast, high-accuracy tuning algorithm as the K3's 100-W ATU. Its LC network automatically tracks the K3's VFO, instantly recalling settings as you tune.

** Elecraft K3s were the radios of choice for these and other top DXpeditions:*

K1N	*Navassa Island – 2015*
TX6G	*Austral Islands – 2014*
FT5ZM	*Amsterdam Island – 2014*
K9W	*Wake Atoll – 2013*
NH8S	*Swains Island – 2013*
TX5K	*Clipperton Island – 2013*
HKØNA	*Malpelo Island – 2012*
3B9SB	*Rodrigues Island – 2012*
5TØSP	*Mauritania – 2012*
7O6T	*Yemen – 2012*
VP8ORK	*Orkney Island – 2011*
9H9BH	*Malta – 2011*
STØR	*S. Sudan – 2011*
5R8X	*Madagascar – 2010*
VK9DWX	*Willis Island – 2009*
VP6DX	*Ducie Island – 2008*

DXPEDITION K3 APPROVED!

The Elecraft K3 is also the contester's choice... 7 out of every 10 rigs selected for the 2014 WRTC were K3s.

ELECRAFT®

For complete features and specifications, go to **elecraft.com** • **831-763-4211**

Steve Ford, WB8IMY, upfront@arrl.org

Celebrating Everything "Antenna"

The best equipped amateur station in the world is worthless without an antenna. To amateurs, antennas are more than functional — they are works of art. We appreciate them all, no matter how large or unusual!

A Antennas don't have to be large to be unique. Dave Beckler, NØSAP, of Nixa, Missouri, made this "Fly Swatter" 6 meter antenna out of aluminum gutter-guard material. During a VHF contest, Dave managed to work 13 states and the country of Colombia while mobile.

B On June 16, 2014, photographer Kem Hartley captured this spectacular image of a storm as it approached the Yagi antenna and tower of Ellwood Brem, K3YV, in Spring Mills, Pennsylvania.

C One morning John Fuller, K4HQK, of Alexandria, Virginia, awoke to a spectacular sunrise. He grabbed his camera and snapped this photo with his 6 meter Yagi antenna in the foreground.

D A "sun dog" crowns the antennas of Marty Dempsey, W2EX, of Ogdensburg, New York. Sun dogs are halos created by sunlight interacting with ice crystals in the atmosphere. According to Marty, this well-placed halo lasted only a few minutes.

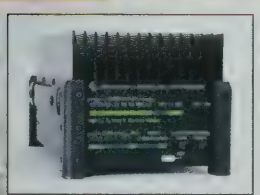
ELECRAFT

KX3

The Revolutionary KX3 All-Band/All-Mode Transceiver

The KX3 is a competition-grade transceiver that literally puts the world in the palm of your hand. With its large display, rich control set, and adjustable operating angle, the ultra-compact KX3 is equally at home on your desktop, in a vehicle, or in remote field locations. It's a true software-defined radio (SDR), with dual watch, noise reduction, digital voice recorder, RX/TX EQ, VOX, speech compression, and CW keyer. The built-in PSK31 and RTTY modes work with or without a computer. Add the internal ATU, battery charger, and roofing filters for unmatched portability and performance.

NEW! ***Make Your KX3 Even More Versatile With These Great New Options***

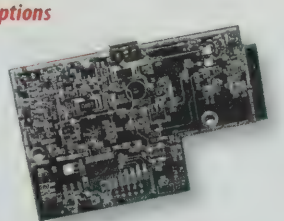


KXPA 100 Automatic Amplifier for the KX3 and Other QRP Rigs

Our compact 100-W amp is ideal for desktop or mobile use. Features fast, PIN-diode T/R switching and large convection-cooled heat sink for reliable and quiet operation. Optional internal ATU provides a wide matching range and dual antenna jacks.

PX3 Panadapter adds a visual dimension to signal hunting

The PX3 provides fast, real-time spectrum and waterfall displays, plus one-click QSY. Its small size and low current drain make it ideal for travel use. Features 2 to 200 kHz span, noise blanker, USB interface, and full integration with the KX3.



KX3-2M/4M module adds 2 or 4 meter capability

Intended for both local emergency communications and casual all-mode use, the KX3-2M and -4M modules provide power output of 2.5 – 3 W typical at 13.8V and excellent receive sensitivity. Includes full FM/repeater support including CTCSS tones and DTMF.

KX3 Transceiver Specifications

KXPA 100 Amplifier Specifications

ELECRAFT®

For complete features and specifications, go to www.elecraft.com • 831-763-4211

Keep HF Mobile in Range

Mobile Antenna Management System for Screwdriver Antennas

Control your Antenna, Wherever you Go!

Ground Breaking Features

- Fully automatic SWR mobile antenna tuning!
- Enhanced CAT mode supports receive tuning
- Adjustable backlit LCD shows SWR, frequency & more!
- 35 memories for favorite band spots
- Programmable motor direction, speed & stall current
- Adjustable auto & manual speed settings
- Handles up to 800W
- Works with 2-wire or 4-wire screwdriver antennas
- Audible SWR alarm
- Uses ARES/RACES recommended Anderson Powerpoles®

Access Automatic Tuning with CI-V/CAT Enhanced Mode!

For Icom CI-V, Kenwood CAT (TS-480), or Yaesu CAT (FT-817/857/897)

Mount almost anywhere with TARGETuner Controller Mounting Brackets!

SKU #58426-1539

Find our full product line at your favorite dealer or on the web:

www.westmountainradio.com/QST315

Find a dealer near you: www.westmountainradio.com/dealers

West Mountain Radio

Makers of RIGrunners & RIGblasters

sales@westmountainradio.com

(262) 522-6503 x 35

MADE IN THE USA

Powerpole® is a registered trademark of Anderson Power Products

ALINCO®

Quality. Style. Performance!

Distributed in North America by
REMTRONIX

1.9~29MHz 100W
All Mode + SDR Transceiver

DX-SR9T

A HYBRID MAGIC.

Now you can enjoy the thrill of DX QSO all over the world with the Alinco DX-SR9T.

A new desktop radio designed to be affordable without compromising performance, the DX-SR9T boasts an analog easy-to-use transceiver featuring 3 ceramic filters with narrow modes and optional mechanical filter insertion capabilities; excellent 1ppm stability and an internal voice/data VOX circuit to easily interface the data-communication modes such as SSTV and PSK31.

Yes, the DX-SR9T is a hybrid, stand-alone analog and digital SDR transceiver, yet simple operating commands, straight forward and logical key layout assures that you can start enjoying this state-of-the-art transceiver from the moment you first power up!

With front-panel separation, large bright LCD display, front facing speaker, Auto-keyer and many other desired features the DX-SR9T is ready to capture the attention of everyone from a beginner in the world of Shortwave to the most experienced operators!

A personal computer of certain specification is required for SDR and Data-communication operations.

REMTronix, Inc.
2560 Barrington Ct.Hayward, CA 94545 U.S.A.
Ph: 510-298-5100 Fax: 510-887-0314 Website: http://www.remtronix.com
Email: alinco@remtronix.com Service: alincosupport@remtronix.com

Products intended for properly licensed operators. Required products are FCC part 15/IC certified. Specification subject to change without notice or obligation. ALL warranty claims and requests for repair/technical assistance for Alinco products should be sent to REMTronix regardless of contact information found on the warranty certificate packed with the product.

letters@arrl.org

Letters from Our Members

One Call, Two Dreams

For many years, my father, Ted Johnston, W8TFI (SK), dreamed of visiting ARRL Headquarters but, sadly, it was not to be. Today I have my father's call sign and I shared his desire to visit the "Mecca" of Amateur Radio. Last September, I finally realized that goal and fulfilled both of our dreams.

The tour guide led me through the hallways and I was impressed by the level of professionalism shown by the staff. It made me proud to be a member. At the conclusion of the tour, I arrived at W1AW, the Hiram Percy Maxim Memorial Station. Station Manager Joe Carcia, NJ1Q, asked if I wanted to go on the air as W1ØØAW (the ARRL Centennial call sign in use at the time). He showed me to one of the studios, set up the antenna system for 17 meters, and pointed the Yagis toward Europe. Joe warned me that I might find myself in a pileup, and he was right! It was hectic, but it was also an experience I will remember for the rest of my life.

It was such a pleasure to speak with everyone at Headquarters. Had it not been for them, I would not have been able to fulfill my dream — and my father's. I miss having QSOs with my father, and I thank the ARRL for being here for both of us for all these years.

Brian Ted Johnston, W8TFI
Warren, Michigan

Paper Licences

I noted with interest your article in the latest issue of *QST* encouraging the FCC to continue providing printed copy licenses. I heartily agree, although perhaps not for the reasons you discuss.

I have been approached three times in the last 12 months by law enforcement officials demanding to know the particulars about my mobile radio.

I travel near the Canadian border on a regular basis. Two of these instances were with the US Border Patrol. After requesting that I roll down a window so that they could view the inside of my vehicle, I was questioned at length about my mobile radio. After producing a copy of my pocket card license, issued by the FCC, the questioning ceased, and I was allowed to go on my way.

The third instance was a stop by a local law enforcement official attempting to stretch the mobile communications act to a two-way radio. No, I was not driving in an erratic manner, nor do I drive a "porcupine." My late-model Jeep sports only a very discreet 2 meter quarter-wave mag mount antenna. Once more, on producing my license, I was sent on my way.

Given this type of treatment, I agree, the FCC needs to continue providing a printed license, on official stock.

Joel Fiske, KC2VAW
Savona, New York

■ The "Happenings" column in the January 2015 issue said that the FCC proposes to discontinue issuing paper licenses. I think a reasonable compromise would be to make the license permanent, with no expiration date. Those receiving a new, upgraded, or modified license would receive a new piece of paper. My GROL (General Radiotelephone Operator License) has no expiration date, so it is not unprecedented. The FCC hasn't received any revenues from amateur licensees for quite some time.

William Capper, WB9LPW
Morris, Illinois

■ I read your article in January's issue of *QST* with interest because I had just modified my ham license (and a commercial license) for a seasonal change of address. At the time I submitted the renewal, I was thinking that it seemed pointless for the FCC to respond by sending me a paper copy when I could simply print it myself.
But after reading the ARRL's arguments for the FCC to continue mailing paper copies as the default action, I'd have to agree with the ARRL's position.

I thought you might be interested to hear, however, that the paper copies I received for both my ham and commercial licenses were printed on ordinary white paper — the kind anyone could buy at an office supply store or Walmart for use with a laser printer. The FCC has apparently discontinued using the safety paper with the FCC watermarks — or perhaps they temporarily ran out.

If the FCC has permanently eliminated the watermarked paper, it certainly diminishes the value in FCC printing and mailing.

Dick Lamb, KØKK
Indian Harbour Beach, Florida

Origins of Phonetic Alphabets

I share William Sterling's ("Correspondence," December 2014) distaste for made-up phonetics, and for a good reason: while an instructor in Communication Procedures for the Air Force and NASA, back in the early '80s, I learned how the NATO Phonetic Alphabet was developed. Pilots on international airline flights were having difficulty communicating with ground controllers who spoke a different native language, leading to misunderstandings and repeated transmissions. A subcommittee of the United Nations studied the problem, and came up with a phonetic alphabet that could be understood internationally, even when spoken in English with a heavy accent. NATO military forces use the same alphabet for the same reason.

Unfortunately, an organization of police chiefs decided that the NATO Phonetic Alphabet sounded too military and they developed a separate phonetic alphabet that is loosely based on men's names.

Eric Lemmon, WB6FLY
Lampoc, California

The Ghost of Memory

Kudos on your Navajo code talker article in the December 2014 issue of *QST*. I am seldom moved by an article, but have to admit that I got chills reading it. I was too young to remember much about World War II, but I do remember seeing all the women crying as the soldiers were loading onto the troop trains heading for the Pacific Theater. It left a lifelong image in my mind.

Gary C. Layton, Sr, W6VVV
Hesperia, California

Send your letters to "Correspondence," ARRL, 225 Main St, Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via e-mail to letters@arrl.org. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made by correspondents.

FlexRadio Systems®
Software Defined Radios

4616 W. Howard Lane, Ste. 1-150
Austin, TX 78728
Phone: 512 535 4713 / Fax: 512 233 5143
Email: sales@flexradio.com

REDISCOVER RADIO WITH THE POWER OF A FLEX-6000

FILL ALL YOUR OPERATOR NEEDS & EXCEED EVERY EXPECTATION

Rediscover Radio...

Now everyone can rediscover radio with the FLEX-6000 Signature Series transceivers with SmartSDR. Experience the excitement of radio again with a solution tailored for you both in capabilities and price. Experience multi-dimensional amateur radio as it was meant to be. From CW to the latest digital modes, FlexRadio Systems helps you rediscover your hobby like no other solution can.

Our offering includes a choice in high-performance 100W HF transceivers with feature sets tailored to your needs. You can have from two to eight simultaneous receivers, contest grade preselectors, high definition display modes, ATU, GPS and more. All running our leading edge, easily upgradeable, SmartSDR software, keeping you ahead of the curve with game changing features and functionality, including a developer's API.*

So visit ***www.flexradio.com*** and see how you can rediscover radio.

*Features/capabilities/pricing vary by model number. Refer to www.flexradio.com for more detailed information.

FlexRadio Systems is a registered trademark and SmartSDR is a trademark of FlexRadio Systems

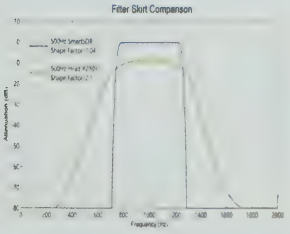
FLEX-6700 Performance*

IMD DR3	Up to 108dB	
RMDR	2kHz	116dB
	20kHz	124dB
TX Phase Noise	1kHz	-133dBc/Hz
	10kHz	-143dBc/Hz
	>100kHz	-150dBc/Hz

*FLEX-6700@14MHz
Typical as measured

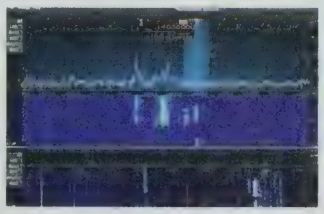
CHART TOPPING PERFORMANCE

Industry leading transceiver performance specifications make the FLEX-6000 series the HF transceiver family of choice for the discerning operator.



INDUSTRY BEST DSP FILTERING

The FLEX-6000 Signature Series transceivers provide brick wall filters with 115dB ultimate rejection, virtually eliminating adjacent channel interference.

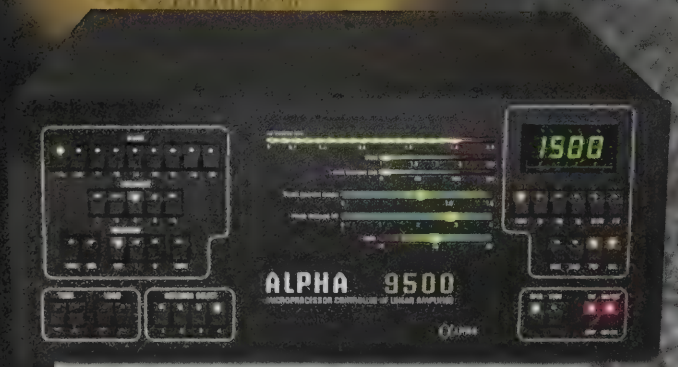


LEADERS IN VISUAL SPECTRUM DISPLAY

Dig deeper into the DX with high definition panafall and waterfall display modes to make DX chasing easier than ever.

www.flexradio.com

ALPHA AMPLIFIERS



Regular Price: ~~$7,995.00~~
Sale Price: $6,995.00

ALPHA 9500

1500 W Auto-Tune Linear Amplifier

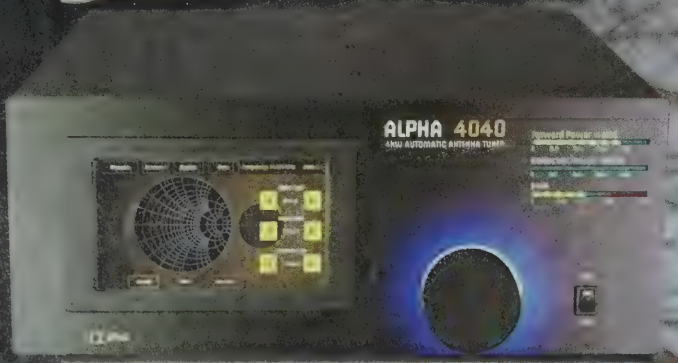
- 3CX1500A7/8877 tube
- Operates on all Amateur HF Bands – 160 M thru 10 M modifiable for MARS operation
- Operates at 1500 W average power and 100% duty cycle with no time limit!
- 4-port automatic antenna switch, any 2 antenna ports may be combined
- SWR tolerance 3:1 at full rated output
- Quickly and automatically tunes to match the load impedance
- Remotely controllable – RS232 and USB port

Regular Price: ~~$5,495.00~~
Sale Price: $4,995.00

ALPHA 8410

1500 W Manual-Tune Linear Amplifier

- Uses a pair of 4CX1500B tetrodes, good for 3 kW of plate dissipation
- Operates at 1500 W average power and 100% duty cycle with no time limit!
- Operates on all Amateur HF Bands – 160 M thru 10 M modifiable for MARS operation
- SWR tolerance 3:1 at full rated output



Coming Soon

ALPHA 4040

4 kW Automatic Antenna Tuner

- Will match all 20:1 SWRs from 1.8 to 30 MHz
- Switches designed for 2800Vpk and 20 Amps at 30MHz
- Ability to combine two of the antenna ports and the 4040 will match and remember the new impedance
- Two 60 A, 7500 V vacuum variable capacitors
- A custom made, 28 uH edge wound variable inductor capable of handling 20A plus RMS, at 30 MHz
- Switchable 380pF 12kV pad cap
- 4 switchable unbalanced outputs

SALES 1-844-73-4-HAMS

www.rfconcepts.com

TEN-TEC and ALPHA AMPLIFIERS are RF CONCEPTS companies

Ask the Ham Who Owns One™

TEN-TEC

Omni VII package
588AT Transceiver with:

- Built-in Auto Tuner
- CW and Sideband filters included
- Model 707 Regal Microphone
- Model 716 Microphone Stand
- Model 707T8 Microphone Cable

Regular Price: ~~$3,381.00~~
Sale Price: $2,499.00

Eagle package
599AT Transceiver with:

- Built-in Auto Tuner
- CW and Sideband filters included
- Model 320 Noise Blanker
- Model 702 Hand Microphone

Regular Price: ~~$2,193.00~~
Sale Price: $1,499.00

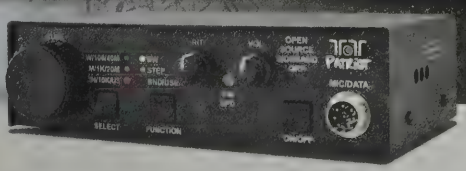
Argonaut VI package
539 QRP Transceiver with:

- Convenient small size
- 10 W QRP
- CW and Sideband filters included
- Model 702 Hand Microphone

Regular Price: ~~$1,069.00~~
Sale Price: $849.00

Patriot
507 Open Source SSB/CW QRP Transceiver:

- ChipKIT Uno32 32-bit, 80MHz processor with 128K of flash memory
- DDS based VFO for no drift operation
- 100% Open source hardware & software
- Covers 20 and 40 meter bands
- Hardware hooks for user added features
- Digital mode access through micro-phone connector
- Auto-selects SSB or CW when either a microphone or a key is used



Price: $299.00

Alpha Amplifiers Office 303-473-9232 TEN-TEC Office 865-453-7172

Prices subject to change without notice.

How Do You Spell Value?? SteppIR

SteppIR DB-18E

=

Multiple Monobanders

SteppIR Antennas provide the best VALUE in Amateur Radio Antenna systems available today!! When you consider that a single SteppIR yagi provides true monoband performance on every frequency the antenna covers, and compare what it would take to duplicate that performance with equivalent individual antennas, the advantages are obvious and the savings are **real**!! Some manufacturers attempt to achieve multiband performance with lossy traps or loading coils. This results in significantly reduced efficiency and limited bandwidth. Other manufacturers use interlaced elements or log-periodic designs to achieve multiband coverage, but at the expense of greatly increased weight and wind-loading requiring much larger towers and rotators, adding cost and complexity.

By precisely adjusting each element's length remotely, SteppIR offers a wide range of yagi antennas that all offer the same advantage....true monoband performance on EVERY frequency the antenna covers!!! It does this with a single boom, a single set of elements, a single feedline and a very simple control cable. The SteppIR controller in your shack provides total control over the antenna's performance including features not available on any other antenna system. Features like nearly instantaneous 180 degree pattern reversal and bi-directional radiation are at your fingertips. Perfect SWR on every frequency. You get ultimate frequency agility and maximum performance and efficiency with every SteppIR. So what does this mean to you?? More performance and value than any other multi-band yagi antenna in Amateur Radio today.

It's not rocket science....it's antenna science at its best.

For more information on which SteppIR is right for you, visit our website or phone our friendly and knowledgeable sales and technical support staff today.

SARK-110 Antenna Analyzer — ***AVAILABLE NOW!***

SteppIR

Hear and Be Heard

SteppIR Antenna Systems • Bellevue, WA 98004 • 425-453-1910 • www.steppir.com

Escape with the TM-281A

On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.

As tough as nails, this MIL-STD-compliant transceiver delivers powerful performance, excellent audio clarity, and a host of advanced features. It offers superb operating ease day or night thanks to the large backlit LCD and illuminated keys. So the next time you take off, take the TM-281A.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

Scan with your phone to

A Talking Frequency Counter

An Atmel ATtiny85 microcontroller measures the frequency and synthesizes the voice output in this pocket-sized accessory that's accurate enough for most shack applications.

Andrew Woodfield, ZL2PD

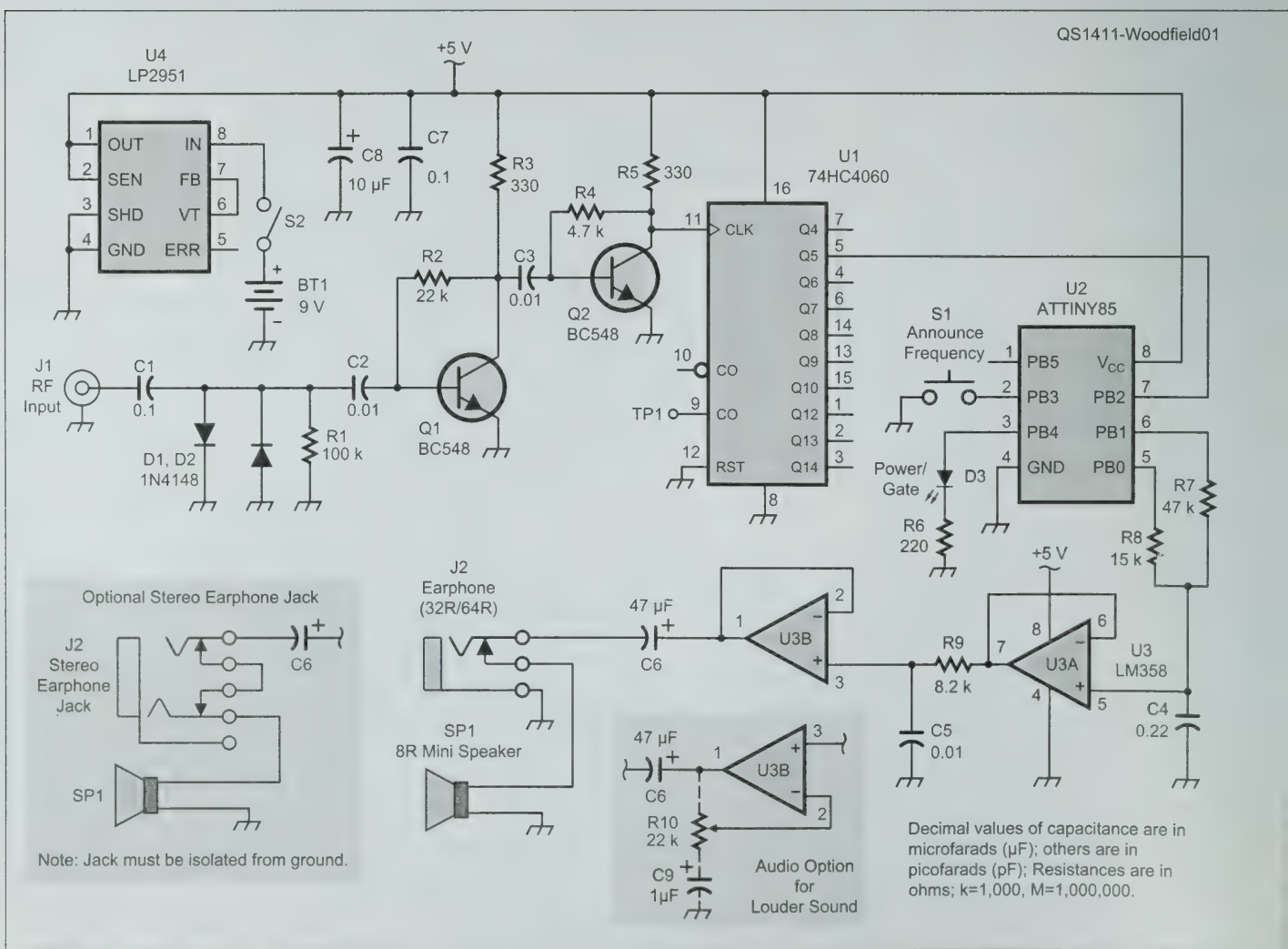
I live in the middle of the Saudi Arabian desert surrounded by silicon, but unfortunately not the kind found at RadioShack. While there are parts suppliers here, there isn't one near me. My job as an advisor to the Saudi Arabian telecommunications regulator is rewarding, but one of the downsides is the difficulty in obtaining components for my electronics hobby. If I require a component and it's not in my parts cabinet, then I need to come up with a Plan B.

This was the case for a pocket-sized frequency counter that I recently put together. For this type of project I would normally use an LCD for the readout.[1] However, I did not have one in my stock, so as an alternative, I chose sound over sight. Morse code was certainly an option with a proven past.[2] While Morse code output is easy to implement in software, the population of qualified users is limited and decreasing. So instead, I chose to go with voice output, even though the software would be more challenging. The more I thought about the idea, the more I liked it: voice output is certainly a plus for the vision impaired and it allows the user to focus on taking a measurement without looking away.

Before exploring the challenges of voice synthesis with a tiny microcontroller chip along with the software development, we'll look at the hardware and its construction.

Hardware and Circuit Description

Figure 1 shows a schematic of the unit. A simple two-transistor preamplifier com-



prised of Q1 and Q2 amplifies and shapes the incoming signal so that it can clock the 74HC4060 CMOS counter U1, which divides the input frequency by 32. It is important to make sure the signal passed to the ATtiny85 U2 is within the measurement range of the microcontroller's counters, which count the number of pulses received from the divider U1.

The value in the ATtiny85's counter is then converted to individual digits using software, and each digit of that result is converted to digitized speech. The digital voice signal reading out the value of each digit is sent out using two pins on the microcontroller. The digital levels on these pins then pass through a simple RC network comprised of R7, R8, and C4 and then on to a two-stage buffer audio amplifier comprised of operational amplifiers U2A and U3B. The low cost and widely available eight-pin LM358 is ideal for this application. U3B drives either a small 8 Ω internal speaker or an 8 to 64 Ω earphone.

The schematic also shows an optional arrangement if a greater volume is required. This extra volume requires two extra parts and the volume gain is not substantial, but it may be of use in some situations. However, some settings of R10 for the highest volume settings can give greater distortion and reduced clarity, so some care is required.

High impedance headphones, such as a crystal earpiece or older 2000 Ω impedance magnetic headphones, could be connected directly across C4, avoiding the need for the buffer amplifier. However, the audio level here is relatively low and probably only suitable for quiet environments.

The LP2951 power supply regulator is fed from a standard 9V battery and delivers a constant 5 V rail to the remainder of the circuit. The current drain is about 50 mA, perhaps a bit high for a 9 V battery, but in typical intermittent use an alkaline battery will deliver a reasonable service life.

Figure 1 — Schematic diagram of the talking frequency counter. All resistors are ¼ W 5%.

BT1 — 9 V battery with snap-on connector
C1, C7 — 0.1 µF ceramic capacitor
C2, C3, C5 — 0.01 uF ceramic capacitor
C4 — 0.22 µF film capacitor
C6 — 47 uF 16V electrolytic capacitor
C8 — 10 uF 16V electrolytic capacitor
D1, D2 — 1N4148 general purpose silicon diode
D3 — Green 3 mm LED
J1 — RCA jack
J2 — monaural or stereo earphone jack as required
Q1, Q2 — BC548 or similar general purpose NPN small signal transistor
R1 — 100 kΩ
R2 — 22 kΩ
R3, R5 — 330 Ω
R4 — 4.7 kΩ
R6 — 220 Ω
R7 — 47 kΩ
R8 — 15 kΩ
R9 — 8.2 kΩ
R10 — 22 kΩ potentiometer (optional for increased output modification)
S1 — SPST momentary pushbutton
S2 — SPST toggle switch
LS1 — 40 mm diameter 8 Ω speaker (thin 2 type preferred, eg Sparkfun COM-10722)
U1 — 74HC4060 14-stage binary counter
U2 — Atmel ATtiny85 microcontroller (programming required)
U3 — LM358 dual operational amplifier
U4 — LP2951 low-dropout fixed/adjustable voltage regulator
Enclosure — Altoids tin or similar

Construction

The unit is housed in a metal box that originally contained a locally produced scented powder, sealed in plastic, and fortunately, easily discarded (see Figure 2). A less exotic, but nonetheless workable substitute could be had with an Altoids tin. Take care when drilling the thin metal. I use a "lip and spur" bit, which is also known as a brad point bit. If you only have bevel bits, start with a small hole and gradually increase the hole size using larger bits. A tapered reamer is another option for enlarging holes in thin metal. In any case, center-punch dimples at the hole locations to prevent the drill bit from wandering.

The components are mounted onto a small piece of perforated prototyping board that is held in place with blobs of hot-melt glue. Beneath the board, several layers of plastic film guard against short circuits to the metal box. A thin 40 mm (1½ inch) speaker tucks in nicely and is aligned with a series of holes in the lid, which serves as the front panel. A suitably thin speaker is listed in the parts list and is available from SparkFun Electronics.[3] A speaker from an old cell phone would also do nicely.

Functional labels were printed on a piece of plain paper that is glued to the lid (see Figure 3). Over this, I placed a piece of clear plastic adhesive sheet.[4] I have found that spray adhesive makes a much neater job when gluing the paper to the lid.[5] The precise layout for my panel is shown in Figure 3, but you will probably want to modify it to fit your own container and parts layout.

Voice Coding

I was aware of some of the established methods for digitizing sound, but all of those I'd examined required the use of a high capacity memory chip. For example, a German design used a high capacity EEPROM chip.[6] A Japanese design and a similar Russian design used an external 2 GB SD (gigabyte Secure Digital) card.[7,8] While providing good quality sound, I thought it might be possible to avoid the use of such parts, saving cost and also reducing the final size of the counter.

Generating spoken numeric results obviously requires the ability to at least gener-

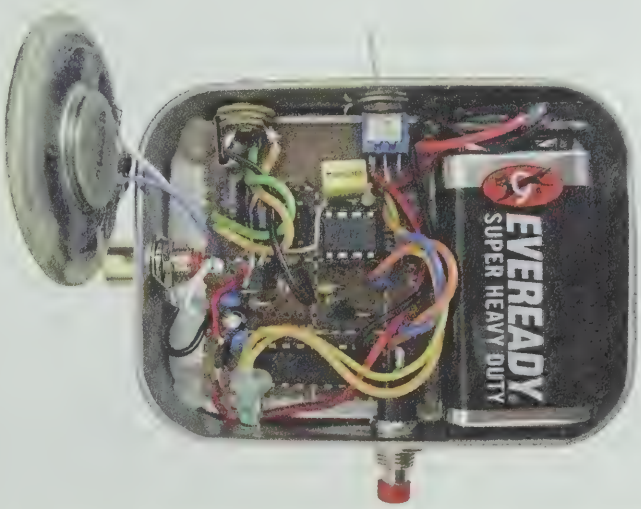


Figure 2 — All the components are housed in a lidded metal container similar to an Altoids tin. An auxiliary headphone jack and power switch S2 are mounted on the side of the container, as shown at the top of the photo. At the left is the RF Input jack J1 and at the bottom is the Gate indicator LED D3 along with Measure pushbutton switch S1.

ate the 10 digits from zero to nine. For spoken frequencies, we also need to add the word "point" for the decimal point in a result, and a few words for the various units. All told, the list adds up to a minimum of about 15 words.

With a memory budget of just 8192 bytes, and reserving about 1000 bytes for the actual program, we're left with a space of less than 500 bytes per word. To give you some idea of just how limiting that is, typical digital voice systems use 8000 8-bit samples each second (i.e. 64 kbps) to deliver a reasonable reproduction of voice frequencies up to 4 kHz. If each spoken number takes about ½ second to deliver, we would need about half of the memory inside the little ATtiny85 microcontroller for just one voiced number. It turns out to be even more difficult than this once some kind of "I'm ready to go" startup announcement and some measurement units ("kilo, "mega," and "hertz") are added to the list.

Fortunately, I was able to make use of the considerable volume of research into digital speech compression over the past few decades. To match the capacity and capabilities of the ATtiny85, I used the elegant Binary Time Constant (BTc) sound compression method developed by Roman Black.[9] This reduces the bit data rate requirement from the typical range of 8 kbps to 64 kbps down to a miserly rate of about 1.6 kbps.

The tradeoff, inevitably, is speech quality. As a result, much of the design time in this project was spent finding an acceptable balance between voice quality, clarity, and the ATtiny85's memory limits. Roman's website has some excellent background material about these issues.

To create the digital vocabulary, I began by making 16-bit digitized files for each word at 16,000 samples per second. Then I converted each file into an 8-bit sampled file at the 8000 samples per second rate used in the counter using the public domain *Audacity* sound processing software, and adjusted each word file to maximize clarity, level, and tone.[10] Finally, these were converted to BTc compressed 1.6-bit speech format using the software available on Roman Black's website. Each word file was then imported into a byte-level editor to remove any unnecessary bytes from brief unvoiced breaks between phonemes, for example, as well as at the start and end of each word. (I used the public domain *HxD Hex Editor*.[11]) While this was a time-consuming process, it resulted in a significant reduction of data memory and it also allows a motivated builder to "port" the design to a different language.

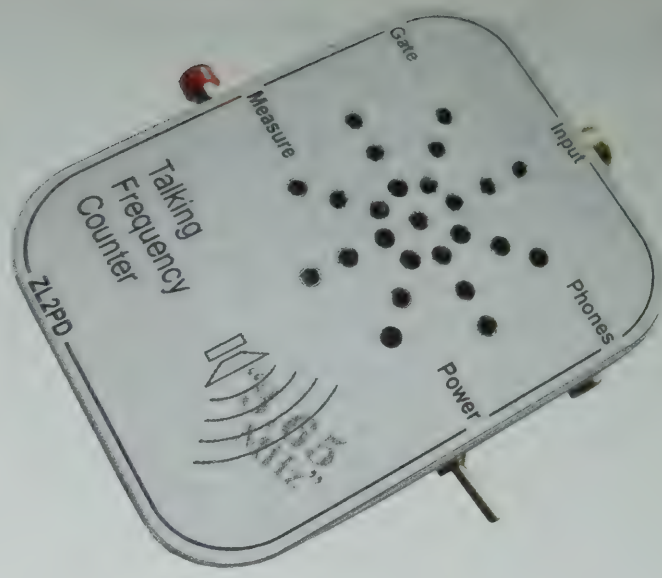


Figure 3 — The front panel nomenclature is printed on a piece of paper glued to the lid of the tin housing the electronics. Clear plastic adhesive film protects the paper.

The voice I used in the version of software provided for this design is male American English (some refer to it as "International English") sourced from AT&T's Text-to-Voice demonstration website.[12] I found the lower frequency range of the male voice to deliver greater clarity in this design than the AT&T female voices.

Software

The frequency counting and speech encoding software used in the ATtiny85 was written using *BASCOM*, a BASIC language compiler for the AVR processor family.[13] This allowed the software to be developed very quickly. My initial idea was tested in just a few hours. The other advantage of using compilers like *BASCOM* is that it makes it very easy for others to reuse the same software source code in other applications.

The frequency counter routines are quite simple. A 24-bit counter made up of a 16-bit hardware counter and 8-bit software counter is used to count the number of pulses received on the ATtiny85's input pin. The counter runs for a known period which is timed using the internal microcontroller's 8 MHz RC-based clock. The software then carries out some simple arithmetic to convert the count into the digits required for the audio result.

The speech encoding is similarly simple. This required shifting and outputting the bits to match the Roman Black BTc encoded data format. Two bits are output for each sample, this providing an improved quality and clarity over a simple 1-bit playback method. Aside from the internal interrupt-based counter timing handled by the processor and the slower rate required for outputting the bits to the audio chain, timing is not a critical factor for the software, and *BASCOM* is easily able to cope with the relaxed demands of this design.

While a public domain version of *BASCOM* is widely available, it has a compiler limit of 4 k bytes. That makes it unsuited to recompiling a new version of this software which uses 85% of the 8 k device program memory. Recompiling a new version required the purchase of the full *BASCOM* version.

Operation

When power is applied, the GATE LED will illuminate and the counter will indicate readiness by announcing, "counter on." Pressing the MEASURE button will cause the ATtiny85 to measure the frequency of any valid signal on the input, up to a maximum frequency of at least 30 MHz, and in most cases, to as much as 60 MHz. The GATE LED will briefly extinguish to show the measurement is in progress. My version is limited to about 30 MHz due to limitations of the elderly 74HC4060 chip I had in my bin. Many new parts will perform above 80 MHz.

Even though the accuracy is roughly

limited to one percent due to the internal RC clock oscillator of the ATiny85 chip, frequencies above 100 kHz are announced with a resolution of three digits, which is useful for tasks like crystal sorting or when the counter is used with a dip meter. Frequencies between 10 kHz and 100 kHz are announced with two-digit resolution. For example, an input frequency of 3.76 MHz would be announced as "three point seven six megahertz."

If the signal level on the input is too low, the counter will report "zero," indicating a larger input level is required. The input impedance of the counter is quite low, but the preamp is very sensitive. If circuit loading is a problem, try temporarily adding a 10 pF or 100 pF disc ceramic in series with the input.

While the enunciation is understandable, you should not expect the clarity of broadcast-quality voice. It's closer to the sound of a cellular phone at the edge of coverage. So, before you build the counter, take a listen to the tests I recorded and see if you think it will meet your needs. I've created a short video, which allows you to see and, more importantly, hear the counter in action.[14]

Programming the ATiny85

One of the easiest ways to program your chip is to use the public-domain *PonyProg* software along with the simple programming hardware, which are fully described on the *PonyProg* website.[15] The software file for this project *talktest07.hex* is programmed into the target chip's program memory and is available along with the *Basic* source code *talktest07.bas* on the *QST* in Depth web page.[16]

PonyProg must also be used to program the ATtiny85's fuse bits. These configure clock speed, reset timing, and some other device functions. These fuse bits should be set as follows: FUSE HIGH BYTE = DE_{16}, FUSE LOW BYTE = $E2_{16}$.

Conclusion

This is an easy-to-build, battery operated, pocket-sized accessory for measuring frequencies around the shack or at the lab bench to an accuracy of a percent or so with three-digit resolution. The measured frequency is enunciated, allowing measurements to be made in dim light and without having to look away from the circuit under test.

Acknowledgments

Thanks to Roman Black for his excellent BTc speech compression software and also to the nice folks at Dontronics in Australia who helped me with my web-based purchase of the full version of *BASCOM*.

Notes

[1]Author's website: **www.zl2pd.com/**.
[2]D. Benson, NN1G, "FREQ-Mite—A Programmable Morse Code Frequency Readout," *QST*, Dec 1998, pp 34 – 36.
[3]Thin speaker: **https://www.sparkfun.com/products/10722**.
[4]Clear plastic sheet: **www.amazon.com/Con-Tact-Brand-Self-Adhesive-Shelf-Liner/dp/B00D8GBO2G/ref=pd_sim_hg_2?ie=UTF8&refRID=1PH68YW9FG99C1YDS0W1**.
[5]Spray adhesive: **www.officedepot.com/a/products/581264/Elmers-Multipurpose-Spray-Adhesive-11-Oz/**.
[6]P. Lajsner, OK2UCX, and R. Vaclavik, OK2XDX, "Voice Output of Measured Values," *Funkamateur*, Dec 2006. (Freescale 8-bit processor and a 4 MB flash memory chip in a temperature meter with voice readout.)
[7]Music player using an ATtiny25 and a 4 GB SD card with WAV-encoded sound: **elm-chan.org/works/sd8p/report.html**.
[8]Microcontroller-based system that selects WAV-encoded sound files from a 2 GB SD card: **www.getchip.net/posts/087-attiny2313-sd-card-talking-device/**.
[9]BTc sound compression method: **www.romanblack.com**.
[10]*Audacity* sound editing software: **audacity.sourceforge.net/**.
[11]*HxD Hex Editor*: **mh-nexus.de/en/**.
[12]AT&T voice source: **www2.research.att.com/~ttsweb/tts/demo.php**.
[13]*BASCOM*: **www.mcselec.com**.
[14]Details are available on the *QST* in Depth web page: **www.arrl.org/qst-in-depth**.
[15]*PonyProg*: **www.lancos.com/prog.html**.
[16]ibid. 14.

Photos by the author.

First licensed as a teenager, New Zealand native Andrew Woodfield, ZL2PD, has been a radio amateur for nearly 40 years, contributing a variety of design articles to New Zealand's Amateur Radio magazine *Break-In* and international electronic hobby magazines *Elektor* and *Silicon Chip*. Andrew is a degree-qualified professional telecommunications engineer with over 30 years of experience in wireless network design and rollouts across the Middle East, Asia, Europe, and Latin America. He is currently working as an advisor to the Saudi Arabian telecommunications regulator in Riyadh where he has been based for the past 5 years. You can reach Andrew by e-mail at **zl2pd@yahoo.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

New Products

2014 FT5ZM Amsterdam Island DXpedition Receive Array Combo Package from DX Engineering

DX Engineering is offering a package of components needed to assemble the same four-square vertical receiving array used by the 2014 FT5ZM Amsterdam Island DXpedition. The package includes four ARAV3 active vertical antennas, RFS-2 relay unit, EC-4 control console, TVSU-1B time variable sequencer unit, RPA-1 preamp, RFCC-1 feed line current choke, F type compression connectors and compression tool, cable stripper tool and 1000 feet of direct bury 75 Ω coaxial cable. These systems provide receive capabilities from 100 kHz to 30 MHz, with switching to four directions for significant signal-to-noise enhancements. The active antennas need only a minimal ground system and the array takes up less space than a Beverage receiving antenna. Price: $2174. For more information, or to order, visit **www.dxengineering.com**.

QRP Antenna Tuner Kit from SOTAbeams

SOTAbeams now offers a kit version of their "Mountain" QRP antenna tuner. The Mountain is designed for use with end-fed half-wave antennas from 40 through 17 meters. It may be staked to the ground with the end of the antenna, or mounted with an elevated feed system to keep the end of the antenna clear of the ground. Power rating is 6 W. Price: about $28 kit, about $48 built and tested (without tax for US/Canada). For more information and ordering details, visit **www.sotabeams.co.uk**.

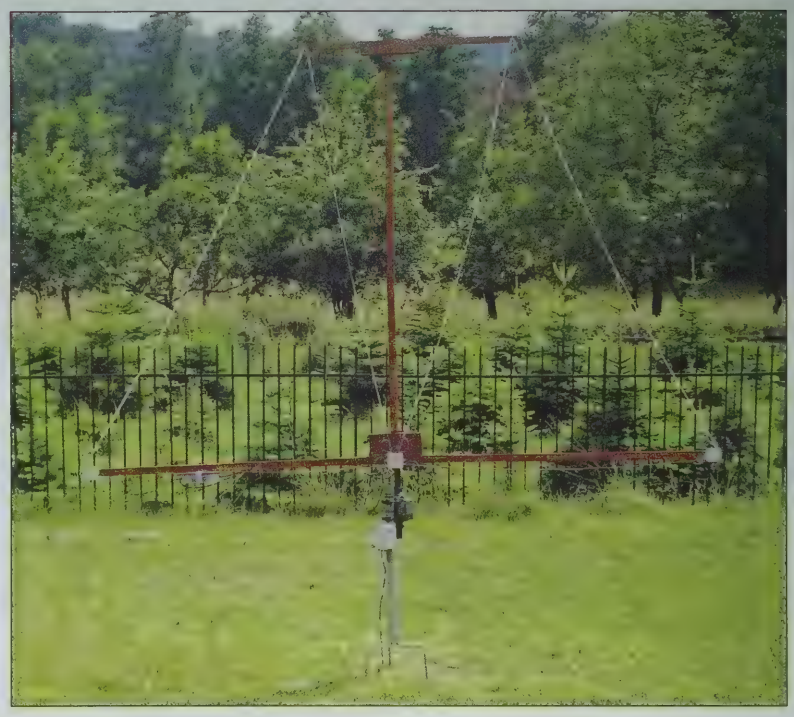
The DK6ED Double Loop

Try these pairs of receiving loops for Top Band.

Chris Kunze, DK6ED

A receive-only antenna is a must for DXing on the lower frequency bands. Transmit antennas are very large for these bands, and they pick up lots of noise so low-level signals are lost. To improve signal-to-noise ratio (SNR), a receive antenna should have a narrow horizontal and vertical beamwidth and a good front-to-back (F/B) ratio.

Here I combined pairs of terminated (magnetic) loops, and phased them so that the radiation pattern has enhanced directivity for improved SNR and a good F/B ratio. One of my systems is rotatable, and the other is fixed in position and can be arrayed.



Receive Antennas

The popular Beverage receiving antenna is a wire at least one wavelength long, mounted close to and parallel with the ground. It is terminated by a resistor on one end and is transformer coupled to a receiver transmission line on the other end. The Beverage antenna is sensitive to an electric field arriving from the direction of the resistor. The Beverage — usually used in noiseless rural areas — has a narrow azimuth and elevation pattern that contributes to its effectiveness.

Magnetic loops — sensitive to the magnetic field — are very small compared to a wavelength, and are useful in noisy areas. Magnetic loops receive equally well from both edges of the loop, but have a null on each side of the loop.

Terminated loops such as the flag, pennant, EWE, and K9AY loop are directional. They are described, along with the Beverage antenna, in Chapter 22 of *The ARRL Antenna Book*.[1]

Combining Loop Pairs

Each of my double loops is a compromise between mechanical dimensions and an optimized radiation pattern. One of my antennas is small and can be rotated (see the lead photo). Its details are in Figure 1. The other antenna is used in a fixed position.

The radiation pattern of my fixed-position double loop system is similar to the pattern of a one-wavelength-long Beverage antenna, but needs only 52 feet of space (Figure 2), compared to the Beverage length of 515 feet. Because of their small size, the signal output of my systems are low, so you might need to use a preamplifier. The SNR of my double loop system is higher than what you get from a single terminated loop, and the SNR does not depend on the output level. I combine the double loop signals in a differential preamplifier, or with a 180° hybrid.

Rotatable DK6ED Loop

Using *EZNEC*, I found the smallest antenna dimensions where the F/B ratio began to deteriorate below my chosen limit of 24 dB.[2] The antenna is quite small, so it can be turned using a small TV rotator. Construction is very simple. I made the antenna's wooden frame from a roof lath and reinforced the corners (see the lead photo). The two transformers and the two resistors are housed in small plastic boxes at the ends and center of the lower support. Take care to build the two loops in a loop pair symmetrically. Make sure the feed lines have equal lengths and that the transformers are connected in the same winding sense.

Despite the small size of this antenna, the azimuth (Figure 3) and elevation (Figure 4) patterns have narrow beamwidths. Signal output is quite low compared to conventional receive loops, so I used a preamplifier.

The RF Preamplifier

Since my antennas are broadband, I opted for a Dallas Langford design of a Norton common base transformer feedback amplifier, available on the J. Miles, KE5FX, web page.[3] I use a differential configuration that provides the needed 0° and 180° inputs (Figure 5). The gain of the Norton stage is about 15 dB.

I mounted this preamplifier in a box (Figure 6) at the base of the antenna and powered it through the coax feed line from the shack. Set each transistor input current to 15 mA so heat sinks are not needed.

[1]Notes appear on page 36.

For alignment, just equalize the currents through R504 and R506 while connected to a 9 V source.

Common mode currents on your feed line can be suppressed by winding the coax line over a big toroid (like an Amidon FT 240-77) close to the receiver.

My small rotatable system is useful for point-to-point operation, or when looking for a station in a known direction. However, for random contacts, my fixed system can switch directions instantly.

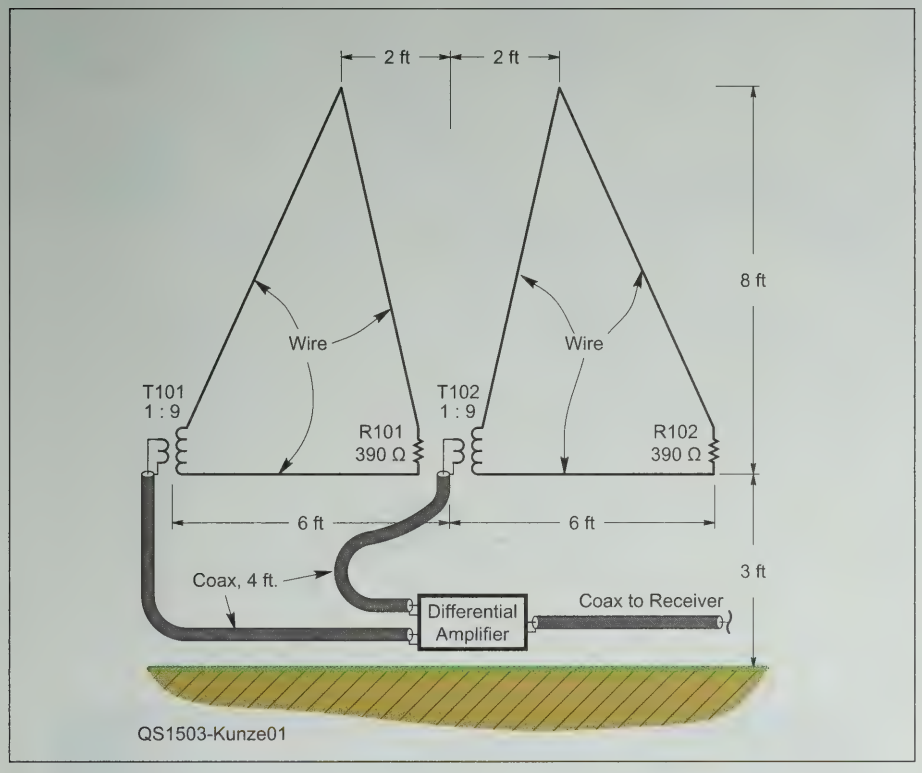


Figure 1 — Rotatable double loop wiring diagram.

R101, R102 — 390 Ω resistor
T101, T102 — primary 2 turns, secondary 6 turns on BN73-202 ferrite core (**www.kitsandparts.com**)
Preamplifier — see text

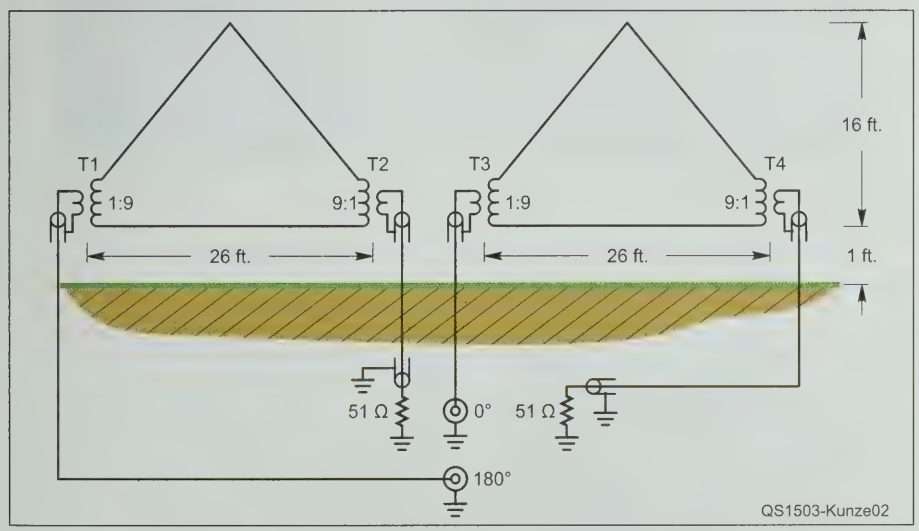


Figure 2 — Double loop receiving antenna for fixed use.

R201, R202 — 82 Ω resistor
T201 – T204 — primary 2 turns, secondary 6 turns on BN73-202 ferrite core (**www.kitsandparts.com**)

The DK6ED Double Loop Array

The double loop shown in Figure 2 is the basis of a fixed-position array. Gary Breed, K9AY, showed how an array of two single loops can cover NW-SE and NE-SW.[4] My array uses two identical double loop pairs and control boxes, one each for the NW-SE and the NE-SW directions. Each control box contains the relays and a combiner. The two control boxes are linked in a third box (Figure 7). Build the loops symmetrically, and pay attention to the sense of the transformer windings. All of the feed lines should have equal length. The antenna patterns in each of the four principal directions are in Figures 8 and 9.

Conclusions

My fixed array system performs best because of its narrower beamwidth and better F/B ratio, and I can scan rapidly in azimuth by just switching the loops. The rotatable

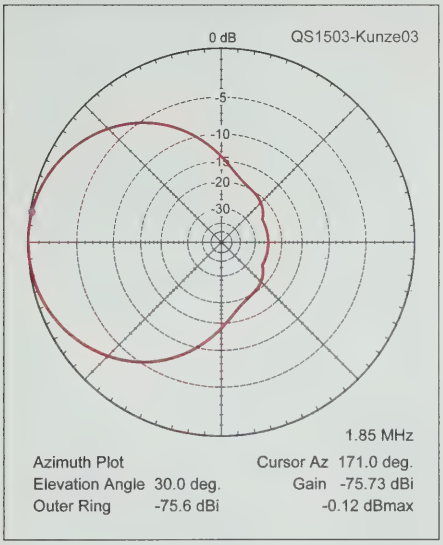


Figure 3 — Azimuth pattern of the rotatable double loop receiving antenna.

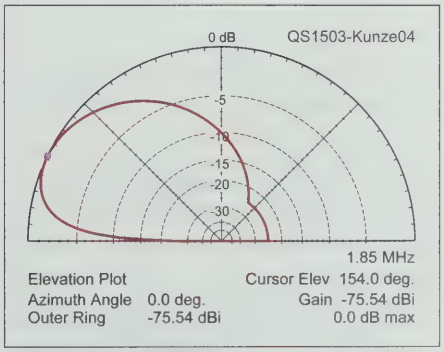


Figure 4 — Elevation pattern of the rotatable double loop receiving antenna.

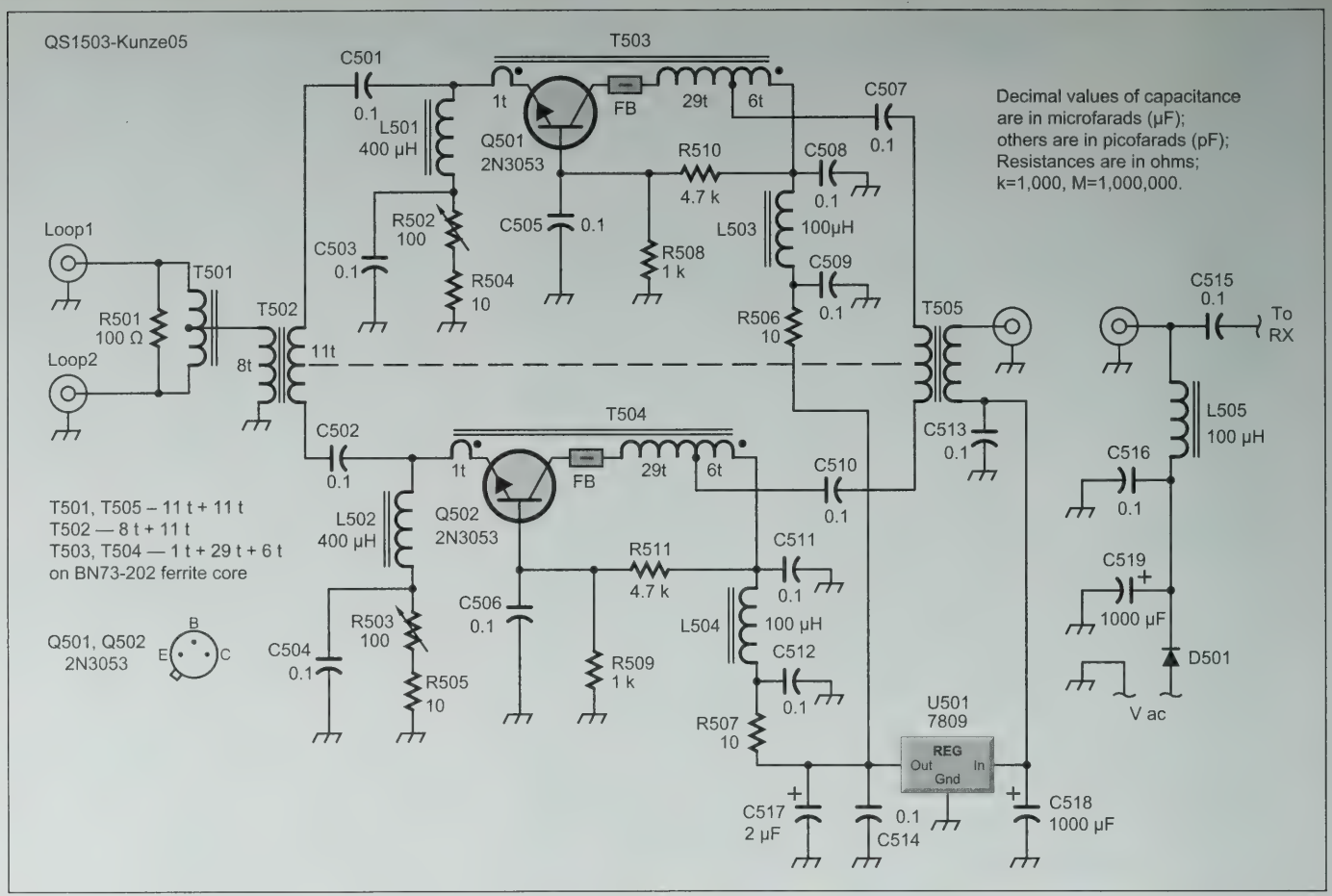


Figure 5 — Preamplifier schematic.

C501 – C516 — 0.1 μF capacitor
C517 — 2 μF capacitor
C518, C519 — 1000 μF capacitor
D501 — silicon diode
L501, L502 — 400 μH inductor
L503 – L505 — 100 μH inductor
Q501, Q502 — 2N3053 transistor
R501 — 100 Ω resistor
R502, R503 — 100 Ω variable resistor
R504 – R507 — 10 Ω resistor
R508, R509 — 1 kΩ resistor
R510, R511 — 4.7 kΩ resistor
T501, T505 — 11 turns + 11 turns on BN73-202 ferrite core (**www.kitsandparts.com**)
T502 — 3 turns + 11 turns on BN73-202 ferrite core
T503, T504 — 1 turn + 29 turns + 6 turns on BN73-202 ferrite core
U501 — 7809 regulator
FB — Ferrite beads

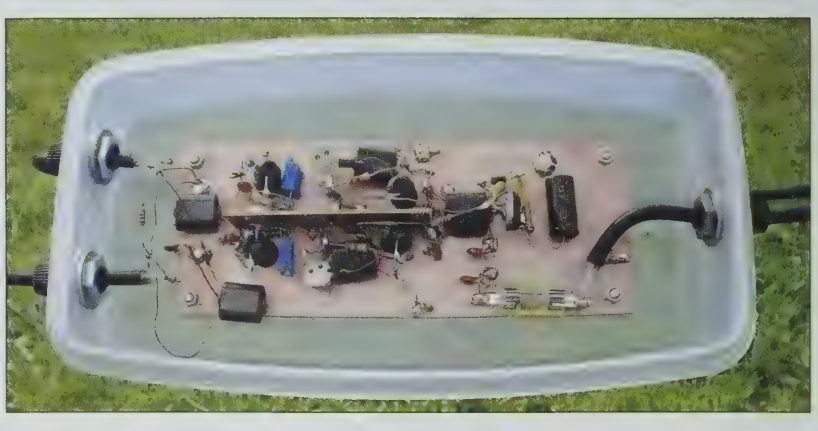


Figure 6 — Preamplifier mounts in a plastic box.

system is very easy to build and can be carried around looking for the location with the lowest local noise level.

In actual use, my new double loops improve the SNR by as much as 25 dB. I experience F/B ratios of 20 – 30 dB, as predicted from the simulations.

Any kind of double loop in a noisy area will, of course, not outperform a Beverage antenna in a low-noise area, but nevertheless I enjoy significantly improved reception.

Notes

[1]*The ARRL Antenna Book*, 22nd Edition, ARRL order no. 6948, available from your ARRL dealer, or from the ARRL Store, Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[2]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

[3]**www.thegleam.com/ke5fx/norton/lankford.pdf**

[4]G. Breed, K9AY, "The K9AY Terminated Loop — A Compact, Directional Receiving Antenna," *QST* Sep 1997, pp 43 – 46.

Photos by the author.

Dr.-Ing. Christoph Kunze, DK6ED, was born in 1956 and has been licensed since 1972. He earned 5-Band DXCC in 1979, and was #1 DXCC Honor Roll 2002. Chris is a structural engineer with a doctorate in environmental engineering. He is ex-officer in charge of a German municipal fire brigade, and is now busy in development aid. You can reach Chris at **dk6ed@darc.de**.

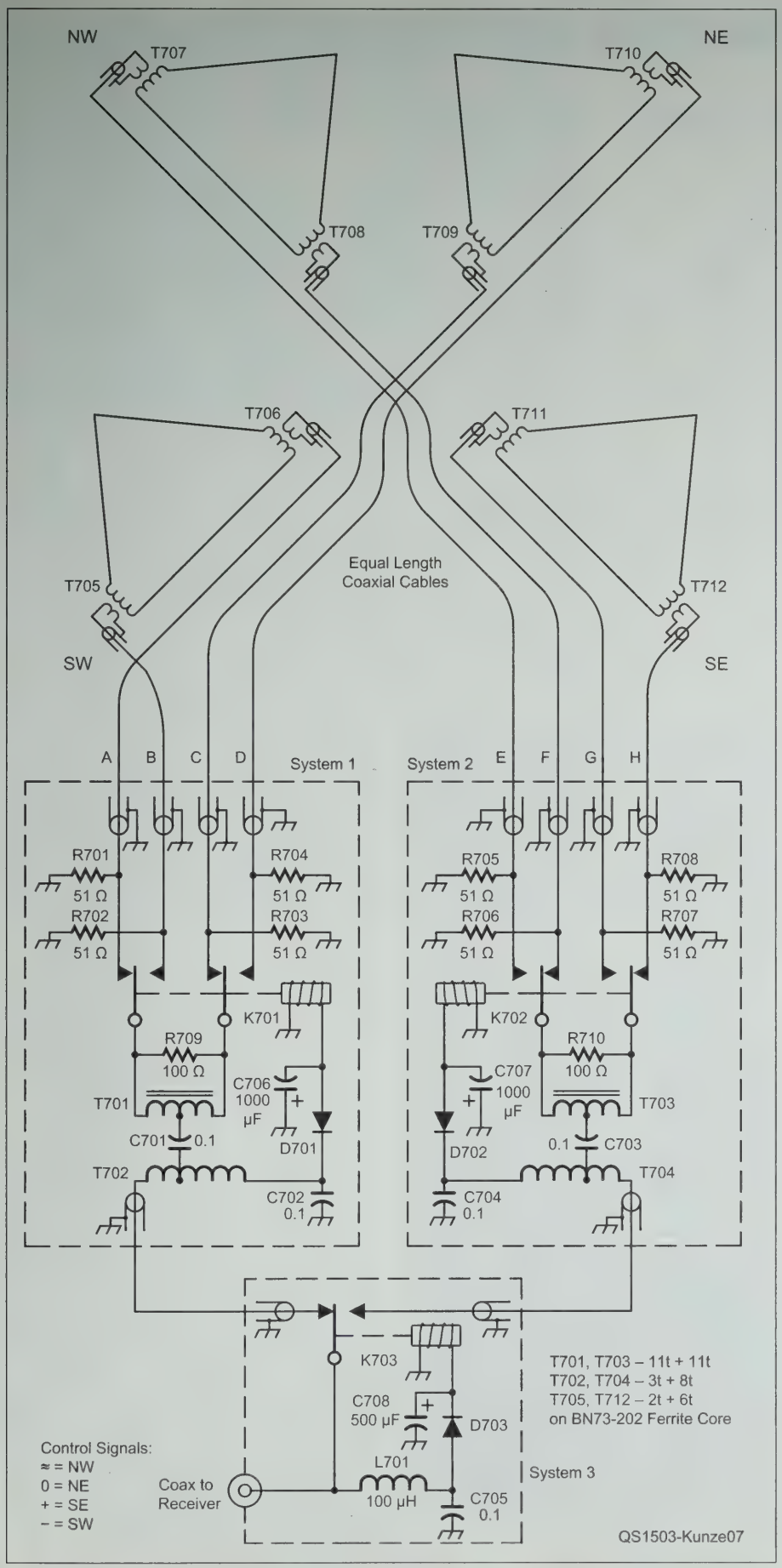


Figure 7 — A pair of bi-direction loop pairs cover four principal directions.
C701 – C705 — 0.1 µF capacitor
C706, C707 — 1000 µF capacitor
C708 — 500 µF capacitor
D701 – D703 — silicon diode
K701, K702 — DPDT relay
K703 — SPDT relay
L701 — 100 µH inductor
R701 – R708 — 51 Ω resistor
R709, R710 — 100 Ω resistor
T701, T703 — 11 turns + 11 turns on BN73-202 ferrite core (**www.kitsandparts.com**)
T702, T704 — 3 turns + 8 turns on BN73-202 ferrite core
T705 – T712 — 2 turns + 6 turns on BN73-202 ferrite core

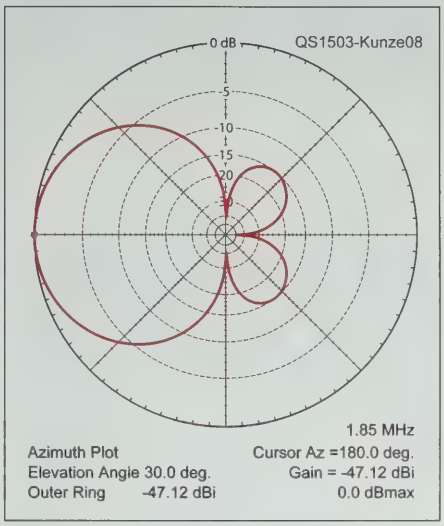


Figure 8 — Azimuth pattern of the fixed double loop receiving antenna.

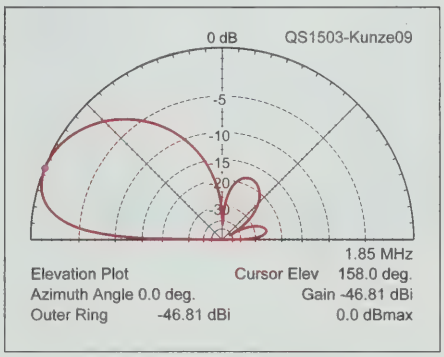


Figure 9 — Elevation pattern of the fixed double loop receiving antenna.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

The WØIH Tunable 80 Meter Dipole

This dipole mechanically tunes over the entire 3.5 to 4 MHz band.

Michael Foerster, WØIH

Like many hams, I've wanted a dipole that covers the entire band from 3.5 to 4 MHz. An idea came to me when I saw one end of my old standard dipole held with a pulley to a flexing tree branch. Why not put pulleys at the *center* insulator as well? With this vague idea, I produced a drawing (Figure 1) that shows my antenna design. My unique solution is a dipole that can change its length to cover the entire band.

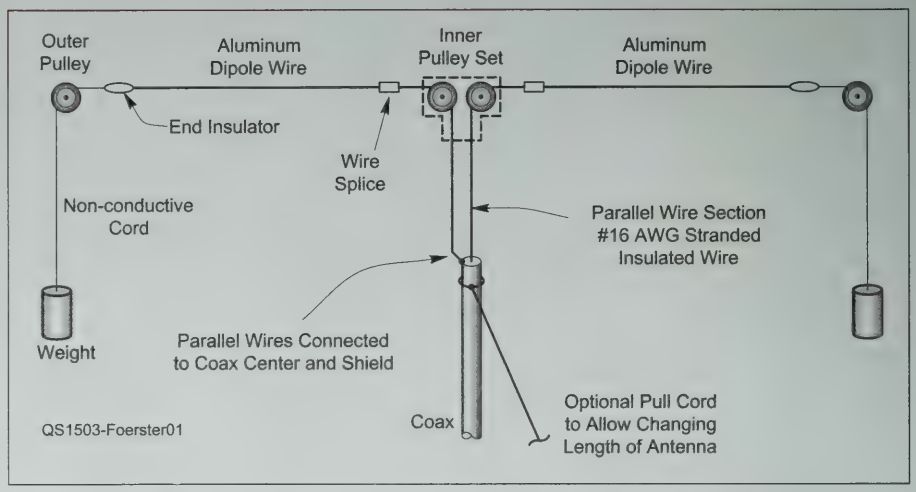


Figure 1 — A sketch of the mechanically tuned dipole.

Finding a Design

I initially worried that the impedance of the parallel wire section that connects to the coax cable might cause a problem, so I spaced the wires very close together, hoping to approximate a 50 Ω transmission line. In a subsequent design, I doubled the wire separation and found that it worked nearly as well.

There were other problems to solve, such as keeping the rain and wind out of the parallel wires without increasing the drag resistance when changing lengths. I found that the wires need to exit the PVC T near the pulleys with a minimum of drag. I found a solution for an antenna design that covers the entire 75 to 80 meter band and can be built for around $30. It does, however, require a rigid center mounting fixture, such as a tower, but the end attachments are much more flexible.

The Design Details

The length of the dipole must change from 117 feet to 133 feet (a total length change of 16 feet) to cover the full 3.5 to 4.0 MHz range. The extra length of dipole wire is pulled down a PVC pipe shaft (Figure 2) to tune the antenna, and becomes a part of the feed line. For my antenna (configured somewhat like an inverted V) an SWR analyzer shows that the impedance at resonance is 60 Ω — a 1.1:1 SWR — anywhere from 3.5 MHz to 4.0 MHz! [The impedance also depends on the dipole height above ground. You can further stabilize the impedance by installing a current choke of several ferrite beads on the coax cable at the transition to the balanced parallel wire section. — *Ed.*]

Figure 2 — The parallel wire PVC housing extends below the weather sealed PVC T hanging from the tower bracket.

Construction

I used a 1¼-inch PVC T fitting to house a set of plastic sliding screen door rollers for the inner pulleys (Figure 3). Suitable pulleys (Figure 4) are available at most hardware stores. I drilled two ¼-inch holes for the 2½-inch × ¼-inch bolts, separated by 1.20 inches, in the PVC T to mount the pulleys.

There should be about 0.4 inches of separation between the inner grooves of the pulleys. The top of the pulleys in the T should be as close to the center of the PVC channel as possible to allow the dipole wires to come out reasonably close to the center. I drilled out two pieces of plastic ⅛-inch thick × 1 inch × 2.5 inches — seen in Figure 3 — to go on either side of the pulleys. This keeps the wires from jumping off the pulleys while assembling and installing the system. I used four ½-inch long pieces of ¼-inch I.D. flexible tubing as a bushing to keep the pulleys and side plates centered (Figure 5). I tightened the ¼-inch × 2.5-inch bolts with a lock washer, making sure I didn't over-tighten, to prevent the PVC T from cracking with temperature changes. The pulleys should turn freely. I drilled another ¼-inch hole in the top of the T (Figure 6) to allow mounting an eyelet to hang the assembly from the tower.

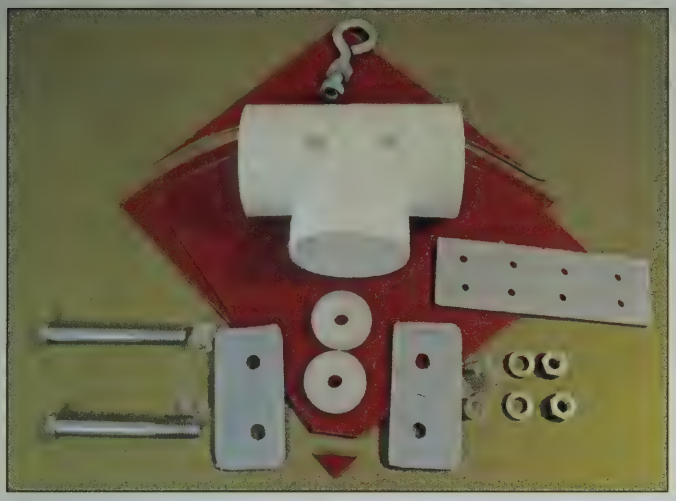


Figure 3 — Components for the tunable dipole.

Figure 4 — A packaged set of hardware suitable for use as pulleys.

Sealing and Waterproofing

To help seal out the weather, I used two 6-inch × 6-inch × 1/16-inch rubber gaskets, available in the plumbing department of a hardware store. I marked off an arc on one corner using a compass (Figure 7) and trimmed the corner. I marked a radius line (2.5 inches from the flared edge) as an approximate glue line guide, and applied contact cement to both surfaces and glued the rubber into a cone shape. I included a small diameter rigid plastic tubing out of the small end. The cones should fit snugly around the ends of the PVC T fitting. I wrapped the cones in white tape to prevent deterioration from the solar radiation. Four tie-wraps secured the cones to the outsides of the PVC T, and another pair of smaller tie wraps held the plastic tubing in place at the cone tips.

The Vertical Tube

I made the vertical tube section from a 10-foot section of 1¼-inch PVC pipe. This protects the parallel line section from the weather and provides stops at the top and bottom. I split another 1-inch diameter PVC tube down the center lengthwise for all but the last 4 inches (Figure 8). This last 4 inches at the top keeps the slider car from allowing the coax to get too high up in the tube. The split tube is then screwed in place at both the top — allowing room for the T to be mounted — and at the bottom, making sure that the inner split tube is straight along the side of the outer tube.

For the parallel wire in the tube, I cut a 25-foot spool of #16 AWG stranded insulated wire in half to connect from the coax and pass over the inner pulleys and out the sides of the PVC T. I spliced the upper wire ends to aluminum fence wire (which I normally use for antennas) with bolts and applied NO-OX-ID electrical grease to prevent the formation of oxides. You can use copper wire for the full length if you like. The wire extensions were each 54 feet long for a total length of 66.5 feet per side. I wound about 6 inches of the outer ends through egg insulators. I also felt that the parallel wires inside the tube should be insulated to prevent any shorts, which could damage the transmitter.

I drilled a 5/8-inch hole in a 1¼-inch PVC end cap to feed the coax through from the bottom of the PVC tube. I stripped the coax end and soldered the wires to the center conductor and braided shield. I then slipped heat shrink tubing over the stripped end of the coax (you could use electrical tape), as well as over the ends of both 12.5-foot lengths of the parallel wire section. I made sure to seal any gaps in the heat shrink tubing with silicone sealant to prevent water from entering into the coax from the wires.

Next, I made a slider car (Figure 8) from a piece of 1/8-inch thick × 3-inch long ×

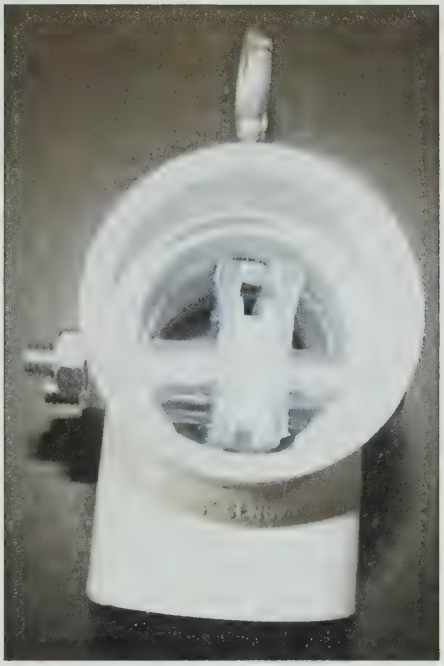


Figure 5 — End view of a pulley inside the PVC T.

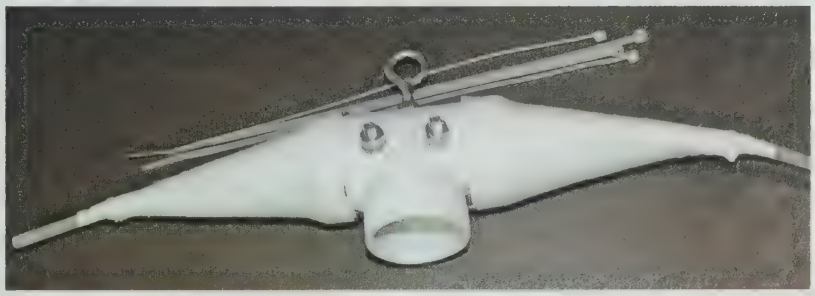


Figure 6 — Secure the finished weatherproof cones on the PVC T with tie wraps.

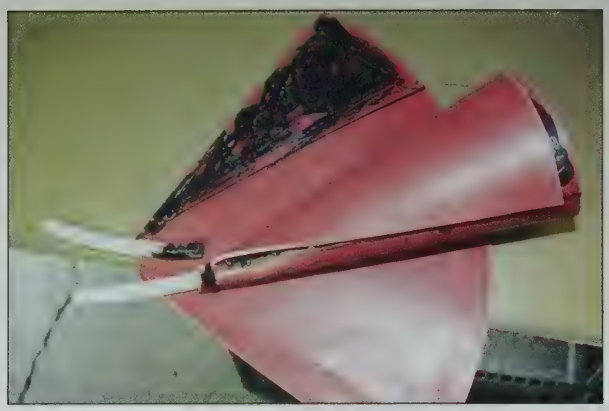


Figure 7 — Make weatherproof cones from gasket material.

Figure 8 — A slider car in the inner PVC shuttles the coax and parallel wires.

Figure 9 — A coax clamp holds the coax in place.

1.25-inch wide plastic. I drilled four sets of holes in the slider car (seen in Figure 3) and used four tie-wraps to attach it securely to the top of the coax cable. This piece should slide along the edges of the split inner PVC tube without binding. The slider car keeps the coax traveler from going too high up the tube when you extend the length of the antenna.

I attached a bottom end cap using two ⅜-inch #6 sheet metal screws at the bottom of the PVC tube. This cap prevents the coax from being pulled out the bottom when shortening the antenna length. I also used the ⅜-inch #6 screws to fasten the PVC tube to the PVC T fitting. I drilled a 3⁄32-inch pilot hole, then drilled only the outer hole with a 9⁄64-inch bit. Using screws rather than glue allows you to disassemble the pieces for future maintenance.

I guided the wires from the PVC tube up through the pulley assembly. I slid the PVC T to the top of the tube, and made certain that the parallel wires were not twisted. I fastened the tube with the sheet metal screws. Finally, I painted the PVC components to prevent deterioration.

Installation

The mounting bracket for the center PVC T needs to be fairly strong to allow pulling the weights at the ends of the dipole. I mounted mine on a tower (Figure 2). The dipole ends can be tied to a tree or other fixture using standard pulleys. The outer antenna ends require 10 feet of movement to allow the end weights sufficient travel. Install the ends high enough, including a safety factor, so that no one will run into the weights. I use RG8U coax and found that the antenna required 7 pound weights on each end of the antenna. If you use a different type of coax cable, then different weights might be required. For details see the February 2013 *QST* article by Joel Hallas, W1ZR.[1] I mounted the antenna in a slight inverted V configuration to keep rain water from running into the PVC T fitting. Note that this mechanical design might be affected by ice.

Adjusting the Frequency

I adjusted the dipole resonant frequency by pulling and holding the coax with an appropriate curved clamp (Figure 9). Optionally, you can use a cord fastened to the coax cable just below the tube to change the antenna length. This cord should not have much stretch. I marked the resonant frequencies of the dipole by wrapping a bright piece of tape around the coax cable, and I then marked my tower leg every 100 kHz, from 3.5 to 4.0 MHz. If you can't get a low SWR at the resonant frequency, check carefully that there is not a twist in the parallel wires inside the tube.

Extending the Design

You might consider adapting this design to use a remotely controlled geared motor and a DPDT switch to change the motor direction. This design can also be adapted to a 160 meter dipole antenna, although a 10-foot-long PVC tube might limit the range of frequency adjustment. This same idea might even work for a multi-band antenna for 20 through 10 meters with the 10-foot tube for adjustment.

However, I attempted this and did not have successful results. With some design changes, it would make a great multiband antenna.

[1] J. Hallas, W1ZR, "How High Should You Hang that Wire Antenna?," *QST*, Feb 2013, pp 50 – 51.

Photos by the author.

ARRL member Michael Foerster, WØIH, holds an Amateur Extra class license. He's been continuously licensed since his first license, WNØVNH, in 1968, then several months later as WAØVNH. He has worked as an electronics technician, and moved into software testing about 25 years ago, which he continues today. His station includes the Elecraft K-Line, the K3, P3, and KPA500, along with a KX3 portable radio and vintage Heathkit SB101, HW101, and SB221 equipment. You can reach Michael at **w0ih@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

VOTE
Did you enjoy this article? Cast your vote at www.arrl.org/cover-plaque-poll

Easy Two-Band Ground Plane for Other Band Combinations

The coupled resonator ground plane antenna can be easily adapted to most band combinations.

Joel R. Hallas, W1ZR

My article from 2013 describing a two-band coupled resonator ground plane antenna made from window line generated a lot of interest.[1] Just as was the case with my earlier two-band dipole article, many inquired about using the design on other band combinations.[2, 3] I modified my *EZNEC* model and prepared designs for the bands requested, as well as some that I thought might be of interest to those who haven't yet requested them.[4] The resulting dimensions are shown in Tables 1 and 2. As shown in Figure 1A, A is the overall length of both the vertical monopole and the two radials while B is the length of the higher frequency parasitically coupled portions of each. C is the gap size. Figure 1B shows the unfolded version — perhaps a bit easier to trim and somewhat larger, but with virtually equal performance. The 6 and 2 meter unfolded dimensions were courtesy of local club member Fred Cunningham, K1FC.

[1]Notes appear on page 43.

Table 1
Folded Coupled Resonator Ground Plane Antenna Dimensions *(Figure 1A)*

Bands (Meters)	A (Feet)	B (Feet)	Gap (Inches)
80/30	51.5	22.0	6
40/20	28.0	15.7	4.8
30/17	19.2	12.05	6
30/15	19.2	10.25	6
20/17	15.1	12.0	6
20/15	14.7	10.25	6
17/12	11.4	8.8	4.8
17/10	11.4	7.67	6
15/10	9.9	7.7	5.4
10/6 (SSB)	6.9	4.3	6

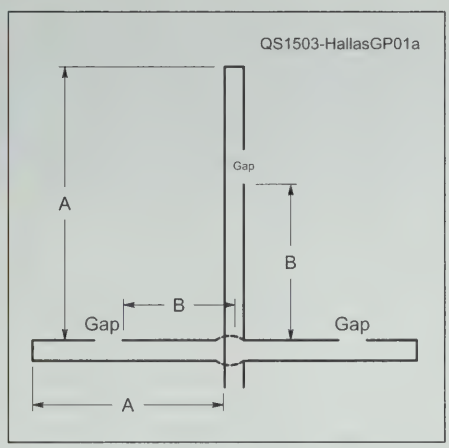


Figure 1A — The configuration of folded coupled resonator ground plane antenna is keyed to the dimensions in Table 1.

Table 2
Unfolded Coupled Resonator Ground Plane Antenna Dimensions *(Figure 1B)*

Bands (Meters)	A (Feet)	B(Feet)
80/60	65.0	41.6
80/40	65.0	31.4
80/30	65.0	21.5
75/60	60.6	41.6
75/40	61.0	31.2
75/30	61.0	21.7
40/30	32.7	21.9
40/20	32.1	15.4
30/17	22.7	12.05
30/15	22.7	10.25
20/17	15.9	12.0
20/15	16.2	10.3
17/12	12.7	8.75
17/10	12.6	7.67
15/10	10.85	7.65
10/6 (SSB)	8.05	4.3
6/2 (K1FC)	4.45	1.46

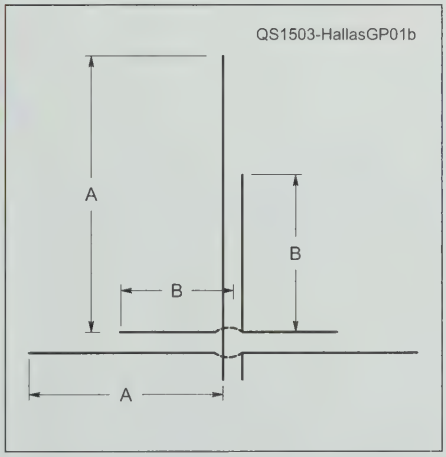


Figure 1B — The *unfolded* coupled resonator ground plane antenna uses full-size elements for each band, as in Table 2.

While the figures show antennas with horizontal radials to make the drawings clearer, the antennas will match the feed line better if the radials are drooped. The higher frequency antennas dimensioned in Tables 1 and 2 were modeled with radials sloped at 45° with the outer ends 8 feet off the ground to avoid a shock hazard. The 80, 75, 60, and 40 meter antennas were modeled with less slope and ends closer to the ground in consideration of the need for higher supports. In general, the modeled conductors needed to be shortened by about 2% to change from horizontal to sloped radials.

The Shortened Single-Band Ground Plane

One reader wondered if this approach could be used to make a single-band shortened 80 meter ground plane. This is accomplished by a variation of Figure 1A in which dimension B is made zero length. With a nominal gap of 12 inches, the antenna will resonate near the bottom of the CW portion if A is set to 42 feet. For the bottom of the phone portion (75 meter subband), A should be set to 40 feet. These dimensions were for a base height of 20 feet with the ends of the radials drooping to 10 feet.

As with most shortened antennas, both the bandwidth and the impedance are reduced. The resonant impedance is around 20 Ω and the 3:1 SWR bandwidth is about 50 kHz. The intensity is about 1.2 dB below that of a full-size ground plane antenna.

Still, if this will fit below your support, and your radio has even the least generous of internal tuners, it could be a workable solution to getting a reasonable low-angle signal on 80 or 75 meters. Note that I have avoided the use of the term "folded" to avoid confusion with the full-size two (or more) wire arrangement.

Builder Beware

As was the case with my dipole, while I actually built and tested the ground plane antennas in the original article, I have not constructed these versions, so it is likely that some tweaking will be required. Reports from constructors have found them close to right on, as shown, however, a change in height, ground conditions, or thickness of 0.0615 inches, for better or worse.

Modeling Coupled Resonator Antennas

Modeling coupled resonator antennas is somewhat complicated by the fact that the wires are close together. Any time wires are close together, special restrictions to the model apply.

Segment Alignment

The primary requirement is that the modeled segments that make up each conductor must be of the same length and in alignment. While this sounds pretty easy to implement, it is complicated by the fact that by their nature, the conductor lengths are different.

In this design, a portion of the wire is coupled and a portion is not. In my early work on the coupled resonator or skeleton sleeve dipole, I spent a lot of time adjusting segment quantities so the lengths would come out equal and aligned in the two coupled conductors, only to have to start over each time I had to make a tuning adjustment. I finally wised up and partitioned each portion of a pair of wires as distinct wires so that each became the same length as its coupled cousin, and by having the same number of segments in each, they automatically were of the same length and in alignment. The concept is illustrated in Figure A.

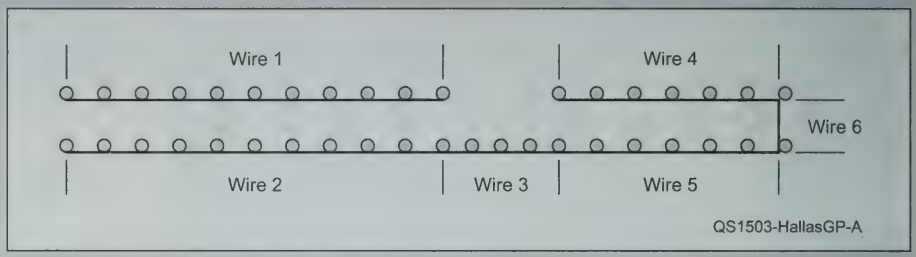


Figure A — Illustration of the alignment of wire segments. The segments in Wire 1 must be the same size and aligned with the segments in Wire 2. Similarly, the segments in Wire 4 must be the same size and aligned with the segments in Wire 5. The segments in Wire 1, however, can be of different length than those in Wires 3, 4, 5, or 6. By having the groups modeled as different wires, it is easy to adjust lengths and still maintain size and alignment within coupled pairs of wires.

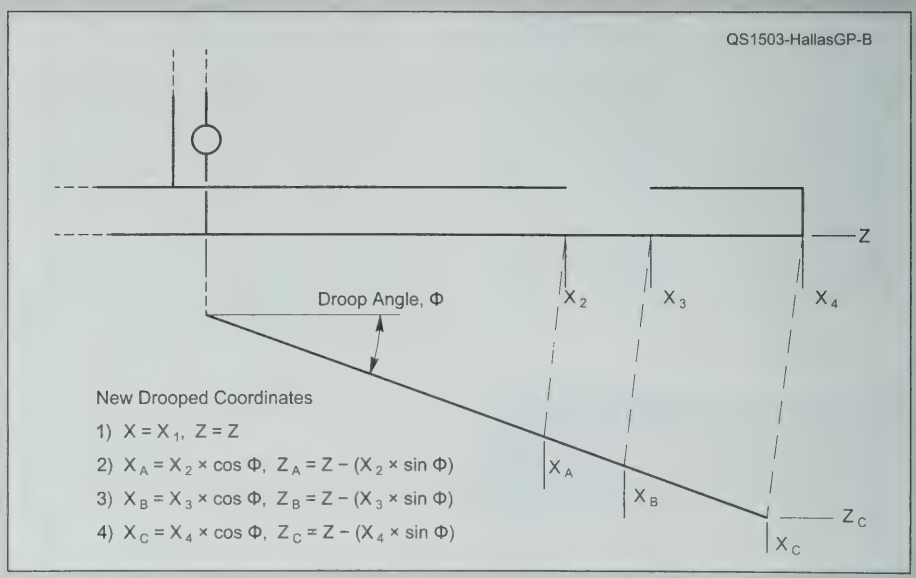

QS1503-HallasGP-B
Z
Droop Angle, Φ
X2
X3
X4
New Drooped Coordinates
1) X = X1, Z = Z
2) XA = X2 × cos Φ, ZA = Z – (X2 × sin Φ)
3) XB = X3 × cos Φ, ZB = Z – (X3 × sin Φ)
4) XC = X4 × cos Φ, ZC = Z – (X4 × sin Φ)
XA
XB
ZC
XC

Figure B — Illustration of one radial showing the methodology of computing the X and Z parameters of drooping radials from the equivalent horizontal dimensions. Note that to minimize the required calculations, I made both wires of the same height and had the spacing between wires occur in the Y direction. The author's *Excel* spreadsheet is available on the *QST* in Depth web page.

Dielectric Properties

It is well established that the dielectric properties of insulated conductors can change the resonant length of antennas. Fortunately, *EZNEC* includes the capability to explicitly define the thickness and dielectric constant of insulation surrounding wire.[A] The relative dielectric constant of polyethylene insulation is well established at 2.25, so we used that in our WIRES table. I measured the spacing between my wires to be very close to 0.06 feet.

What about the effective thickness of the insulation including the web between the wires? Well, we determined the value of that empirically for our window line. Since we had built our antenna and knew all the dimensions and parameters of the real antenna, we adjusted the one remaining parameter, the dielectric thickness, until the model agreed with the real antenna. We ended up with a

Drooping of Radial Wires

Ground plane antennas can be constructed with radials horizontal (perpendicular to the monopole element), or dropping downward at some angle. There is no question that the modeling is simplified if the radials are horizontal, since the Z dimension, or height, is constant along the whole length and the X, or length parameter, is the same as the actual wire length. If you make such a model you will be quickly aware that, just as in real life, the input impedance at resonance is about half of that of a dipole, or about 25 Ω.

While a 25 Ω antenna, with its 2:1 SWR — higher away from resonance — is not the end of the world, it does make for a complication in feed arrangements.

droop angle of the radials will each make a small change in tuning. Also, just as with wire dipoles, a single antenna will not cover all of 80 meters. I thus have one oriented toward the voice segment of the bands (75/60) and one lower in frequency (80/60).

While this design should be adaptable to any of the various parallel window (ladder) lines, the line I used was from Davis RF.[5] The conductors were #18 AWG stranded copper-clad steel — a good choice for both flexibility and strength. If a different type of cable is selected, I would expect that differences in wire dimensions and dielectric properties would necessitate some changes in the lengths shown in order to achieve resonance on each band.

If you build one or more and get them trimmed to frequency, please send me "as-built" measurements details. I will compile them on the *QST* in Depth web page.[6]

Modeling the Coupled Resonator

A number of readers have expressed interest in modeling their own versions for other frequencies. This is certainly feasible, however, there are some aspects of this antenna that impose restrictions on the modeling. The primary one is true for any closely coupled conductors in a *NEC*-based modeling program, and that is that the segment lengths in adjacent conductors must be the same and the segments must be in alignment. The other is that the lengths are impacted by the dielectric properties that exist around and between the conductors. Both of these are discussed in the sidebar "Modeling Coupled Resonator Antennas."

An electrical ¼-wave section of 35 Ω transmission line will transform 25 to 49 Ω or, alternately, the antenna impedance itself can be raised to near 50 Ω by drooping the radials.[B]

The downside, of course, is that with drooped radials the support height must be higher. The upside is that for some increase in height it will also perform better.[C] What it may come down to is that if the lower of the bands is of fairly low frequency, 80, 40, or perhaps 30 meters, a droop may not be feasible, while for higher frequency bands it may work just fine. This is strictly a design choice with clear ramifications.

In terms of modeling, the drooping does require a bit of number crunching to determine the X and Z parameters. It is probably a good idea to start off modeling horizontal radials and get everything resonant where you want it on each band. Then apply the equations shown in Figure B to determine the drooped radial dimensions. For me, that resulted in a shift in resonance that required a small change in lengths of both monopole and radials. I made my radials the same length as the monopole, but for small changes, one could just change the monopole or both radials, if desired.

While the equations can be easily run on a scientific calculator, I found it easier to do them (again and again) by setting them up on a spreadsheet. Pick a new length and apply it to the monopole and the calculation in Figure B. Obtain the new dimensions from the formulas and rerun the model.

I found that a fairly shallow droop, perhaps 15 or 20°, made a big difference in the feed impedance, so it is probably worth doing even if you can't get a lot of height.

[A]Click SHOW WIRE INSULATION at the top of the WIRES table in *EZNEC*.

[B]While 35 Ω transmission line is available, it can be closely simulated by two lengths of 75 Ω line connected in parallel.

[C]J. Hallas, W1ZR, "How High Should Your HF Vertical Be?," *QST*, Nov 2011, pp 51 – 52.

Notes

[1]J. Hallas, W1ZR, "An Easy to Make Two Band HF Ground Plane," *QST*, Dec 2013, pp 35 – 37.

[2]J. Hallas, W1ZR, "A Folded Skeleton Sleeve Dipole for 40 and 20 Meters," *QST*, May 2011, pp 58 – 60.

[3]J. Hallas, W1ZR, "The Folded Skeleton Sleeve Dipole on Other Ham Bands," *QST*, Oct 2011, p 48, "Feedback" *QST*, Nov 2011, p 68.

[4]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

[5]Davis RF ladder line part RF part LL-450-553, **www.davisrf.com**.

[6]**www.arrl.org/qst-in-depth**

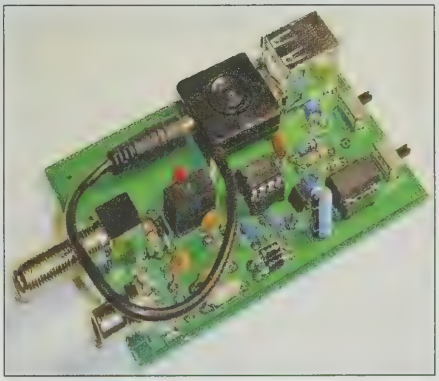
You can reach *QST* Contributing Editor Joel Hallas at **w1zr@arrl.org**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

New Products

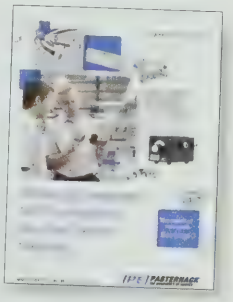
RANVerter Pi SDR Upconverter Kit from Hayseed Hamfest Company

The RANVerter Pi is a new version of the RANVerter SDR upconverter kit that was first described in "Cheap and Easy SDR" by Robert Nickels, W9RAN, in the January 2013 issue of *QST*. The new version is designed to enable the Raspberry Pi credit-card sized *Linux* PC to become a versatile SDR radio server via any Ethernet network. The receiver can also be remotely located and controlled via Ethernet and the Raspberry Pi's GPIO pins, and it is powered from the computer's USB port. The kit includes all components (capacitors, resistors, semiconductors, choke, switches, relay, jacks, and LED), a double-sided PC board with plated thru holes, a standard mini-dongle/USB cable kit, 55 MHz oscillator and oscillator-mixer. Price: $49.95. For more information, or to order, visit **www.hayseedhamfest.com**.



RF Products Catalog from Pasternack Enterprises

The *2014 RF Product Guide* from Pasternack Enterprises is a 264-page catalog featuring thousands of in-stock products such as RF cable assemblies, RF amplifiers, modules, and other passive and active RF components. The new catalog includes an updated Adapter and Cable Assembly Matrix that allows the user to identify all available in-series and between-series configurations. New products include 60 GHz modules, systems and WR-15 antennas, as well as an increase in the active RF amplifier lineup. Additional new products include low PIM cable jumpers, power tappers, ferrite isolators and circulators, Wilkinson power dividers, low loss test cables, and others. Visit **www.pasternack.com** to request a free printed copy or to download a PDF version.



An Off Center End Fed Dipole for Portable Operation on 40 to 6 Meters

This compact design rolls up and fits in a small DX go-bag for easy travel.

Kazimierz "Kai" Siwiak, KE4PT

Your success with low power HF operations increases when you can increase the flexibility of your station. By that, I mean increasing the choices of operating modes, and choices of operating bands. The more choices you have, the more fun you will have. Here I describe an *off center end fed* (OCEF) dipole of my own design that is *physically* end-fed, but *electrically* off-center fed. I needed a simple-to-deploy antenna for portable use that I could easily stow in a small DX go-bag along with a Yaesu FT-817 radio and a tiny Elecraft T1 automatic antenna tuning unit (ATU). This OCEF dipole and ATU combination allows me to operate on all ham bands from 40 to 6 meters. I've even used it on the 80 meter band, with limited success. You can hang the OCEF dipole by one distant end support, or you can drape it in ad-hoc fashion over a fiberglass tent pole (Figure 1) or other convenient support — the ATU adds further flexibility. This lightweight antenna can be rolled and stowed in a small plastic bag for travel. Here's how I built mine.

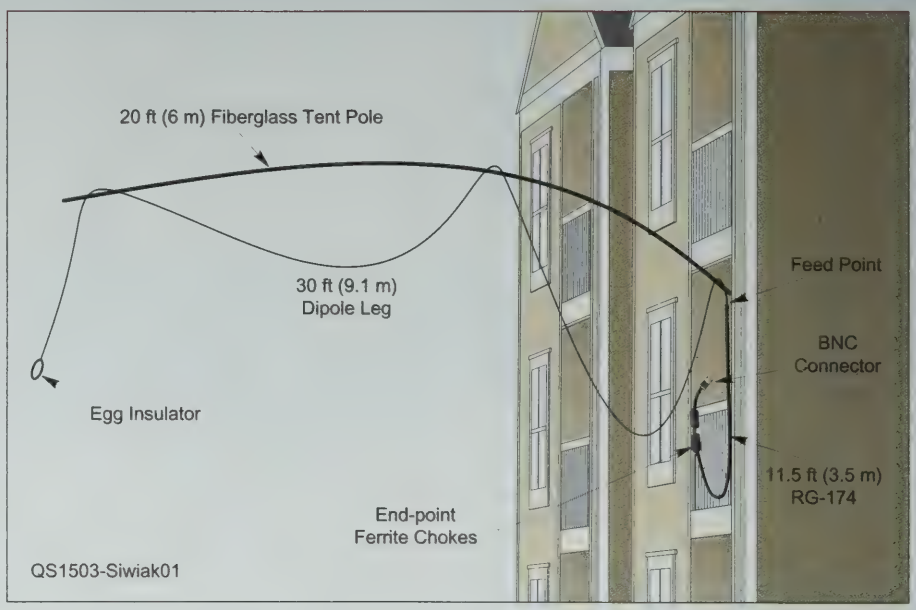


Figure 1 — The OCEF dipole can be drooped from a fiberglass tent pole, as shown here, or stretched out and hung by the end egg insulator.

OCEF Dipole Construction

The OCEF dipole consists of two dipole legs and an optional droop wire (Figure 2). For the far-end portion I used 30 feet (9.1 m) of Teflon® insulated #20 AWG stranded copper wire that starts at the ceramic egg insulator at A. You can also use PVC insulated wire. My wire was salvaged from a twisted pair with yellow and purple insulation, which I unraveled and joined together. Solder it to the center conductor of miniature RG-174 coaxial cable at the *electrical* feed point B. The second radiating portion is the outer shield of the 11.5 feet (3.5 m) long section of RG-174 coax that extends from the electrical feed point B to the ferrite chokes at the physical end of C.

Start with enough RG-174 coax (at least 13 feet; 4 m) so you can wind three turns of the RG-174 coax around each of two ferrite chokes, and terminate the coax in a BNC connector. I chose a BNC female connector so that I can easily add more feed line.

At point C, I added a 2-foot (60 cm) long Teflon covered #20 AWG stranded droop wire to help "tame" the typically high wave impedance at the end of a dipole. This optional wire C – D is the third radiating portion of the OCEF dipole. The electrical end of the antenna is C, or D (if the optional droop wire is used). The ferrite common mode chokes attenuate the radiating currents and keep them from flowing past the choke towards the transmitter.

Theory of Operation

The OCEF dipole is 41.5 feet (12.6 m) long measured from A to C, or 42.4 feet (12.9 m) long from A to D. I chose the two dipole leg lengths A – B and B – C (or B – D) so that they would not be a multiple of a half wavelength on any band of operation.

The radiator length between the egg insulator and the end of the optional droop wire acts like a dipole radiator. This is a non self-resonant design, so you need an antenna match box — I use the Elecraft T1 automatic Antenna Tuning Unit (ATU) — to present a 50 Ω load to the transmitter.

You can attach the optional 2-foot (60 cm) long droop wire to move the very high wave impedance present at the end of a dipole away from the choke, to the end of the droop wire, easing the job of the ferrite chokes. If needed, you can wind the droop wire back around the antenna part of the coax to change the impedance seen by the ATU. Note that changing feed line lengths also changes the impedances presented to the ATU — I normally use a 15-foot (4.6 m) long cable between the antenna and the transmitter — you might need to change this length depending on how your tuner performs.

I chose the two dipole sections of different lengths so that the actual complex impedances at the dipole electrical feed point

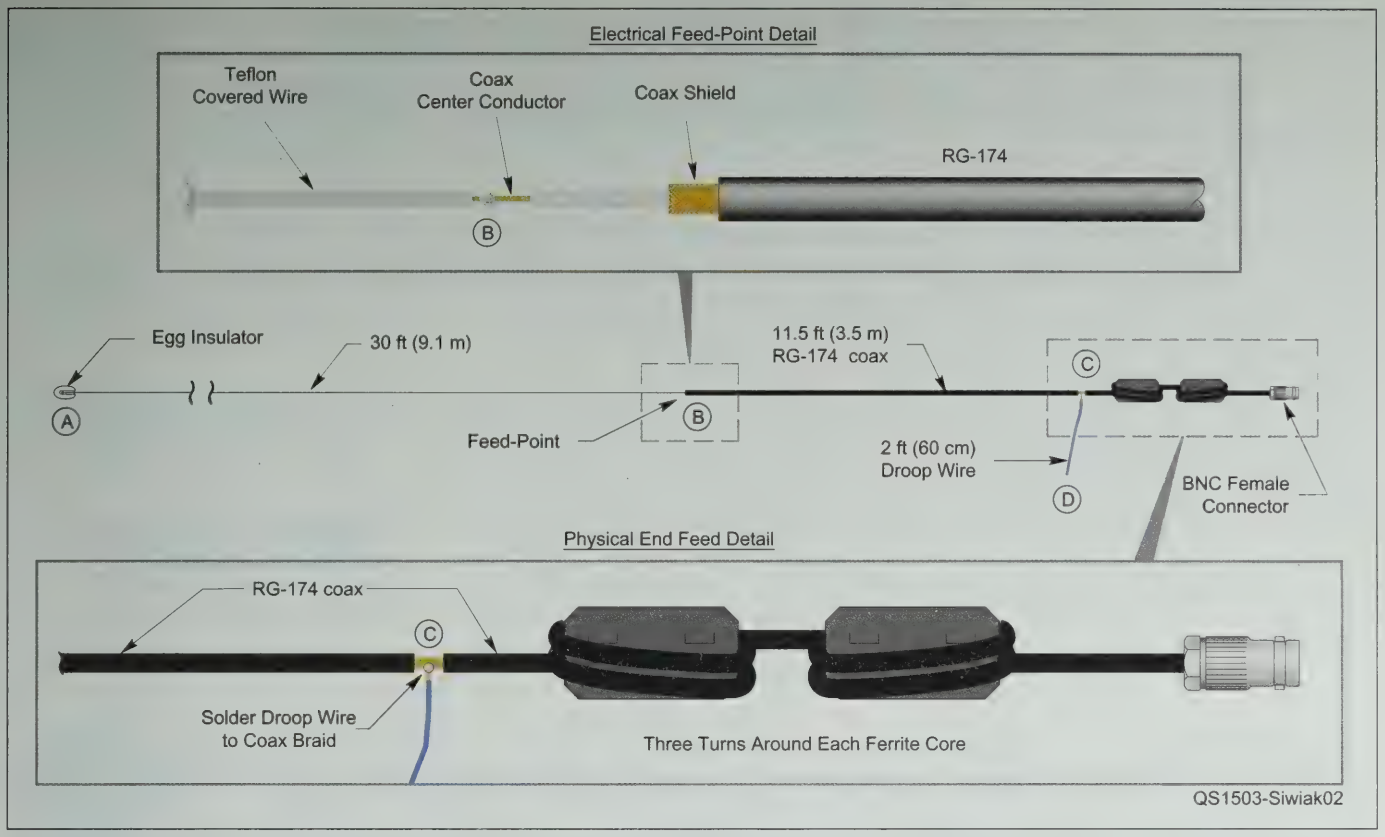


Figure 2 — This OCEF dipole detail shows the radiating portions A – D, details of the electrical feed point, and the common mode chokes at the physical feed end. You need 32 feet (9.7 m) of #20 AWG stranded copper wire, Teflon or PVC insulated (part #125840 **www.jameco.com**), 13 feet (4 m) of RG-174 coaxial cable, 2 snap-on ¼ inch mix-31 split ferrites (**www.Palomar-Engineers.com**), and a cable-end BNC female connector.

Figure 3 — The antenna rolls neatly into a compact package for easy stowing (droop wire not shown). The ruler is 6 inches (30 cm) in length. [Kai Siwiak, KE4PT, photo]

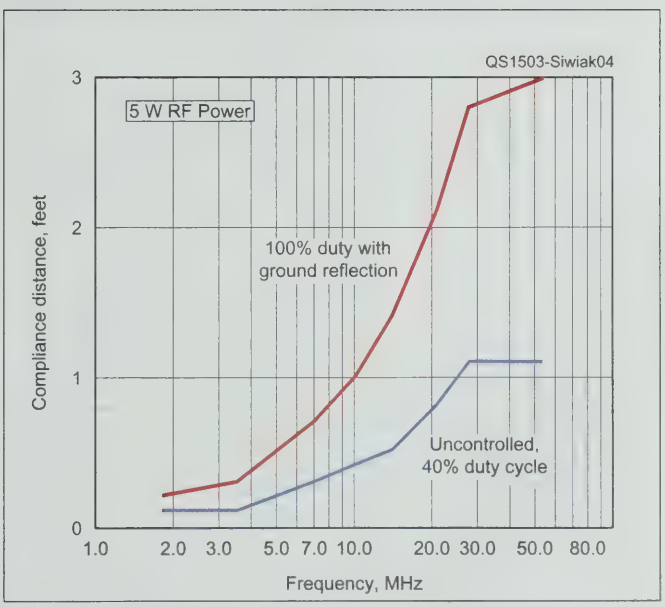


Figure 4 — RF exposure compliance distance for 5 W power. For 50 W multiply the distances by 3.2.

would be relatively easy for the ATU to match. Again, no magic here, just a judicious choice of lengths.

Deploying the OCEF Dipole

When stretched out and hung by the end insulator in an area clear of obstacles, the OCEF dipole is self-resonant near 11.8 MHz and its harmonics (slightly lower with the droop wire). We do not, however, use the antenna near any of the self-resonant frequencies. Antennas do not need to be self-resonant to radiate effectively. With this design, I can match the antenna using the ATU in any ham band from 40 to 6 meters — even and especially — if the antenna is deployed in a random fashion, such as drooped over a fiberglass tent pole, as in Figure 1. I've even had success on 80 meters when the antenna is fully stretched out.

Stowing the OCEF Dipole

Starting at the egg insulator, I wind the wire section of the dipole in figure-eight style around a corrugated cardboard form (6 × 7 inches; 15 × 18 cm). Winding this way prevents twisting in the wire. I then coil the coax portion in a loop (Figure 3), and stow inside the folded cardboard form. The antenna easily fits in a quart (liter) size plastic bag along with additional connectors and jumper cables for the ATU and HF radio.

Using the OCEF Dipole

With 5 W RF power the RF exposure compliance distance (Figure 4) from any part of the antenna rises steadily from 1 foot (30 cm) at 10 MHz to 3 feet (1 m) at 54 MHz. For 50 W RF multiply the distances by 3.2.

When packing constraints limit what I can bring along during travel, this antenna provides lots of freedom in choosing operating bands to let me get my share of DX. The antenna travels well and deploys easily from a hotel room balcony or from a tree at a camp site.

ARRL member Kazimierz "Kai" Siwiak, KE4PT, enjoys DXing and carries a low-power "DX go-bag" station while travelling. You can reach him by e-mail at **k.siwiak@ieee.org**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top five Volunteer Examiners in each ARRL Division according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represent extraordinary dedication! Whether you are one of our VE Teams that tests once a week, once a month, or once a year, we want to express our warmest appreciation to all volunteers for your generous contribution to the ARRL VEC program.

If you are an ARRL VE, you can view your session stats online at **www.arrl.org/ve-session-counts**.

If you are not a VE, become one today! See **www.arrl.org/become-an-arrl-ve**.

Examiner	Sessions	Accreditation Date
Atlantic		
Edward Genoino, WA2NDA	246	10-Jul-85
William Effland, K2GVI	228	06-Sep-84
James McCloskey, NS3K	223	14-Nov-94
George Brechmann, N3HBT	213	01-Apr-91
Donald Wright, Jr, AA2F	186	26-Oct-84
Central		
Allan Bukowski, N9ZD	244	01-Jun-92
Eldon Boehm, NK9U	243	21-Nov-86
George Greene, NE9ET	237	13-Nov-00
Donald Hlinsky, N9IZU	237	01-Mar-91
Timothy Pechtold, AA9BV	232	01-Nov-92
Dakota		
John Schwarz, Jr, AEØAL	235	26-Oct-94
Jeffrey Goodnuff, WØKF	217	17-Jun-03
Dennis Ackerman, KBØOQQ	199	15-Jul-96
Daniel Royer, KEØOR	196	01-Jul-91
Thomas Wilson, NIØI	187	30-Jul-86
Delta		
Arthur Parry, Jr, WB4BGX	228	01-May-91
Edward Scheufele, AB5RS	222	19-Jan-94
William Easterday, KB8FU	209	01-Mar-91
Joan Thorne, KN4PM	172	01-Jan-91
Bobby Livingston, N5YLE	167	01-Apr-93
Great Lakes		
David Schmidt, KI4QH	250	15-Feb-85
Herbert Blasberg, WA8PBW	216	06-Sep-84
Charles Hall, W8HF	212	01-Jun-92
Theodore Wilson, K8TCR	201	19-Jan-90
Claybourne Mitchell, W8JNZ	201	01-Sep-90

Examiner	Sessions	Accreditation Date
Hudson		
Paul Maytan, AC2T	474	06-Sep-84
E. Drew Moore, W2OU	355	01-Aug-90
Gerald Miller, Jr, AA2ZJ	324	05-Dec-95
Daniel Calabrese, AA2HX	305	01-Nov-91
Stanley Rothman, WA2NRV	298	01-Mar-85
Midwest		
Harry Nordman, ABØSX	627	09-Jan-02
David Bartholomew, ABØTO	529	22-Mar-02
Kevin Naumann, NØWDG	489	17-Nov-02
Jeanette Nordman, ABØYX	445	21-Aug-03
Roland Kramer, WØRL	368	21-Jun-01
New England		
Lawrence Polowy, KU1L	294	02-Jan-85
James Mullen, KK1W	278	01-Mar-91
Stefan Rodowicz, N1SR	277	20-Nov-84
Bruce Anderson, W1LUS	275	11-Feb-88
Robert Beaudet, W1YRC	275	01-Aug-90
Northwestern		
Richard Morgan, KD7GIE	407	11-Aug-00
John Mackey, Jr, KSØF	370	01-Oct-90
Loren Hole, KK7M	318	06-Sep-84
George Ftikas, N7TQZ	258	01-Dec-92
Duane Anderson, NA7DA	241	28-Mar-00
Pacific		
Royal Metzger, K6VIP	368	29-Apr-85
Morris Jones, AD6ZH	338	27-Nov-01
Dorothy Hays, N6UDH	242	01-Sep-91
Kenneth Hall, WO6J	230	18-Mar-86
Jim Brunk, N6BHX	202	13-Jul-95

Examiner	Sessions	Accreditation Date
Roanoke		
Judy Friel, AC4RG	232	01-Feb-91
Alan Moeck, WA2RPX	208	27-Sep-94
Thomas Hill, KJ4IV	201	01-Jun-91
David Snyder, W4SAR	186	01-May-93
Sheila Frank, KT4YW	185	30-Oct-96
Rocky Mountain		
Karen Schultz, KAØCDN	408	06-Sep-84
Robert Hamilton, NØRN	319	19-May-87
Frank Goddard, WØAJY	266	01-Feb-92
Henry Luthe, Jr, WØZU	250	01-Jan-92
David Avery, NØHEQ	243	13-Jan-88
Southeastern		
Victor Madera, KP4PQ	375	01-Mar-92
Pablo Soto, KP4SJ	305	01-May-92
Joseph Patti, N4UMB	276	01-Sep-90
Harold Prosser, III, KK1B	268	22-Jan-86
Robert Cumming, Sr, W2BZY	262	29-Jan-97
Southwestern		
Bill Martin, AIØD	592	01-Nov-84
Fred Bollinger,AB7JF	343	17-Apr-95
Steve Gurley, KY7W	309	19-Apr-96
Gary Mangels, AD6CD	286	30-Jul-97
Joseph Cutitta, WØSLL	283	09-Nov-99
West Gulf		
Franz Laugermann,K3FL	585	01-Dec-91
Sammy Neal, N5AF	535	20-Nov-84
John Moore, III,KK5NU	429	21-May-95
Gerald Grant, WB5R	381	04-Jan-85
David Fanelli, KB5PGY	353	01-Oct-91

Standing Wave Ratio — What Does It Really Mean?

Higher SWR means more loss, but more loss can mean lower SWR. Here's how to make sense of this.

Joel R. Hallas, W1ZR
Contributing Editor, *QST*

Standing wave ratio, or SWR, seems to come up in most ham conversations related to antenna systems. SWR is a measure of how closely matched a load is to a nominal impedance — typically the 50 Ω coaxial cable for which most current amateur equipment is designed. An SWR of 1:1 indicates that the load is an exact match to the design impedance, while any other ratio (always greater than 1.0) indicates a mismatch. Some consider it a big deal, while some say it doesn't matter. Can they all be right?

What SWR Is All About

To discuss standing wave ratio, I will start with a discussion of what happens in a real transmission line without standing waves — one with a standing wave ratio of 1:1. Figure 1 shows a typical setup, with an SWR or power meter between the transmitter and the antenna tuner. Of course, for the matched case, we don't need a tuner at all, but sooner or later we will change frequencies and then we likely will.

The Directional Wattmeter

Note that a directional wattmeter that reads forward and reflected power can also tell us about the matched condition — if we read forward power and the reflected power is zero, we have a matched condition, or an SWR of 1:1. If we understand what the power readings mean, the power meter can tell us a bit more — how much power we have at a particular location in the system.

We can determine SWR from forward and reflected power through the following expression:

$$SWR = \frac{1+\sqrt{P_R/P_F}}{1-\sqrt{P_R/P_F}} \qquad \text{Eq 1}$$

Where P_R and P_F are the reflected and forward power in the same units.

You won't need to make this calculation (unless you want to check my work), but it's here if you want to. So, for example, if the reflected power is 1/10 the forward power, the SWR, equals

$$SWR = \left(1+\sqrt{1/10}\right)\Big/\left(1-\sqrt{1/10}\right) \qquad \text{Eq 2}$$
$$= (1+0.316)/(1-0.316) = 1.92:1.$$

This illustrates one weakness of some power meters compared to the usual voltage sensing SWR meter that has a value of 3:1 near mid-scale. The power meter tends to have the values of most interest to us clustered near the bottom end of the reflected power scale, rather than near the middle. Still, the numbers will illustrate our discussion very nicely.

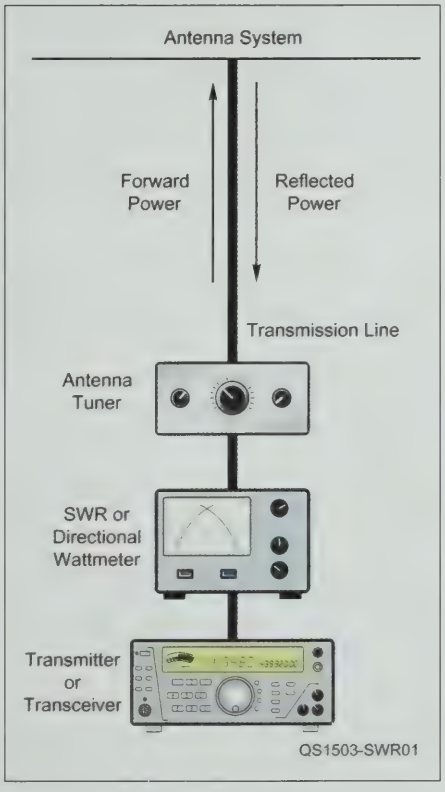


Figure 1 — The usual configuration of an HF amateur station using an antenna tuner to feed an antenna system.

Another important consideration in interpreting a directional wattmeter's readings is that net-delivered power equals the forward power minus the reflected power. Thus, don't be surprised if the meter between a 100 W transmitter and a mismatched load reads 150 W forward and 50 W reflected. It doesn't mean that your transmitter is suddenly putting out more power, it just means that the load has an SWR of 3.7:1.

The Matched Case — SWR = 1:1

If a signal is launched down a transmission line that is terminated in its characteristic impedance — a 50 Ω resistive load for many coax types, including the popular RG-213 (modern RG-8), RG-8X, and RG-58A — the power that reaches the far end will be completely absorbed by the load. If it's an antenna, most of it (less any losses in the coax or antenna itself) will be radiated as an electromagnetic wave — just what we want. If we were to measure (without disrupting things) the voltage and current along the matched line, we would observe that they both remain essentially constant amplitude sine waves as we move down the line, except for a reduction over distance due to line loss.

In Table 1, we have tabulated the loss in 100 feet of matched coax of the types we mentioned above on a number of amateur bands. The loss is expressed in decibels, a logarithmic function and the usual unit for such data because system component losses and gains expressed in decibels can be added together to obtain the total system gain or loss. In terms of power,

Table 1
Matched Loss (dB) of 100 Feet of Three Types of 50 Ω Coax

Coax Type	3.7 MHz	14.15 MHz	28.5 MHz	50.1 MHz	144.2 MHz
RG-213 (Belden 8267)	0.375	0.785	1.153	1.573	2.813
RG-8X (Belden 9258)	0.578	1.251	1.870	2.587	4.751
RG-58A (Belden 9259)	0.868	1.890	2.838	3.936	7.267

Table 2
Fraction of Power Lost and Power Remaining for Various Losses

Loss (dB)	Loss Fraction	Remaining Fraction
0.5	0.109	0.891
1	0.206	0.794
2	0.369	0.631
3	0.499	0.501
5	0.684	0.316
10	0.900	0.100
20	0.990	0.010
30	0.999	0.001

the fraction lost is shown in Table 2 for various decibel values. What this means, for example, is if the cable loss is 3 dB, about half of your power is dissipated in the cable instead of being radiated by the antenna. It also means, sometimes more importantly, that half your received signal is lost before it gets to your receiver.

In Figure 2, I have imagined inserting directional wattmeters at each end of the transmission line. We don't generally do this — often the upper one is in the air, for one reason — but the numbers they would provide make good illustrations. In this case, I imagined that the antenna tuner is lossless to simplify the discussion. I selected the attenuation of a 100-foot length of popular RG-8X, 50 Ω coax, and an operating frequency of 14.15 MHz for the calculations. Nothing about the matched numbers should be a big surprise.

The Mismatched Case — SWR > 1:1

If we terminate the end of the line with an impedance other than the transmission line characteristic impedance, the usual situation for many antennas, the situation gets a bit more complicated. At the interface between the transmission line and its mismatched load (the antenna) a reflection occurs, resulting in a wave returning down the transmission line toward the source. This wave is also attenuated as it travels back toward the transmitter, but it exists all along the line. Note that while the antenna tuner is matched to the impedance of the mismatched antenna transformed by the coax, it is not matched to the coax Z_0 and the wave encounters the mismatch on the antenna side of the tuner and is thus re-reflected toward the antenna.

Figure 3 is a repeat of Figure 2, except that now instead of a matched load, we have an antenna with an impedance of 12.5 Ω, a 4:1 SWR. The figure shows the power and SWR readings that we would see at all of the points in our heavily instrumented system. Tables 3 and 4 provide some representative data for other cables and situations. There are a number of key observations that can be gleaned from these results.

First, observe that the loss in the transmission line has increased due to the higher SWR. Instead of the matched loss of 1.25 dB, we now have 2.2 dB of loss. This means that if we start out with 100 W, only 60 W will reach the antenna, rather than the 75 W we had for the matched case.

At the bottom of the transmission line, it looks like a much better situation, even though it really isn't. The reflected power from the mismatched antenna has been attenuated by the mismatched coax on its way back to the transmitter, so the SWR at the bottom looks much better than it really is. Note that if we had a very lossy, very long transmission line, so that the reflected wave was almost gone, we would see an SWR of close to 1:1, even though almost nothing will get to the antenna. This is why we have to look carefully at what our meter readings really mean.

Note the meter readings between the transmitter and the antenna tuner — these are usually the only ones we actually see! If the antenna tuner is properly adjusted, the SWR here will be 1:1 and we will be sending the full 100 W toward the antenna system, but as we now know, the results are quite different.

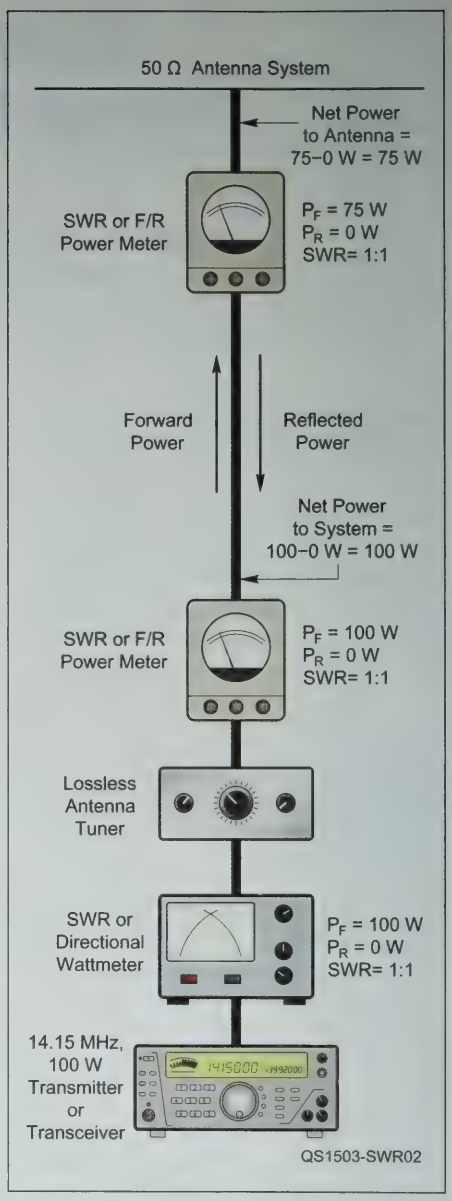

50 Ω Antenna System
Net Power to Antenna = 75–0 W = 75 W
SWR or F/R Power Meter
P_F = 75 W
P_R = 0 W
SWR= 1:1
Forward Power
Reflected Power
Net Power to System = 100–0 W = 100 W
SWR or F/R Power Meter
P_F = 100 W
P_R = 0 W
SWR= 1:1
Lossless Antenna Tuner
SWR or Directional Wattmeter
P_F = 100 W
P_R = 0 W
SWR= 1:1
14.15 MHz, 100 W Transmitter or Transceiver
QS1503-SWR02

Figure 2 — The configuration of Figure 1, showing expanded instrumentation. While this would not typically be used, the numbers that would be obtained will assist in the discussion. For this example, we use 100 feet of the popular RG-8X coaxial cable to connect our radio to a perfectly matched antenna system on 14.15 MHz.

What To Do About It

While the SWR meter that we observe to tune our antenna tuner is crucial in order to adjust the tuner, its readings with the tuner in-line do not tell us much about what's really happening in the antenna system. We can, however, make use of it to get a good idea of what's happening in the following way:

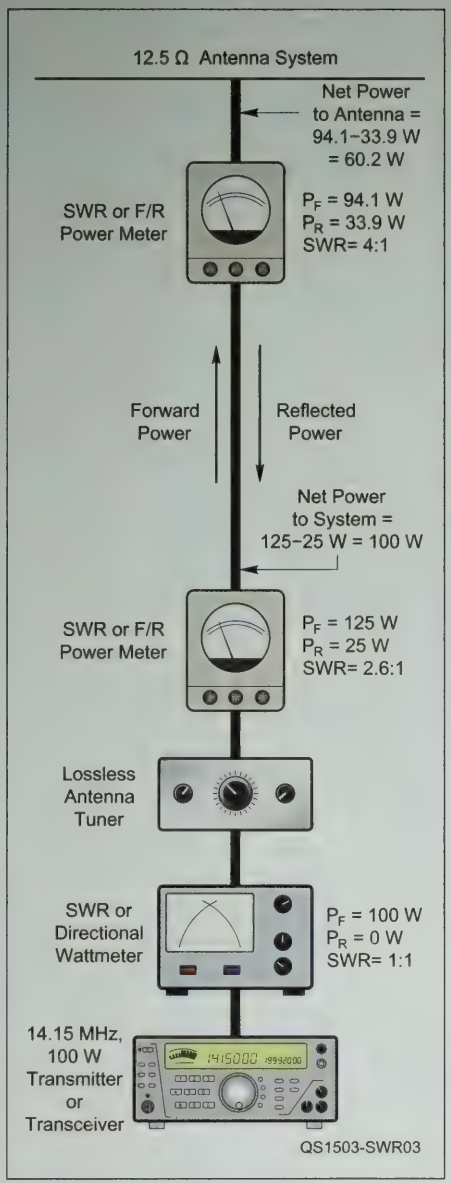

12.5 Ω Antenna System
Net Power to Antenna = 94.1–33.9 W = 60.2 W
SWR or F/R Power Meter
P_F = 94.1 W
P_R = 33.9 W
SWR= 4:1
Forward Power
Reflected Power
Net Power to System = 125–25 W = 100 W
SWR or F/R Power Meter
P_F = 125 W
P_R = 25 W
SWR= 2.6:1
Lossless Antenna Tuner
SWR or Directional Wattmeter
P_F = 100 W
P_R = 0 W
SWR= 1:1
14.15 MHz, 100 W Transmitter or Transceiver
QS1503-SWR03

Figure 3 — This is the same situation as Figure 2, except that the antenna has an impedance of 12.5 Ω, a 4:1 SWR. Note that due to the loss in the transmission line going up to the antenna, and in the reflected signal coming back, it looks at the radio end as if the SWR is just 2.6:1. Even more confusing is the meter at the radio, showing 100 W out going to a perfectly matched system.

Table 3
Loss (dB) of 100 Feet of Three Types of 50 Ω Coax Feeding 12.5 Ω Load (4:1 SWR)

Coax Type	3.7 MHz	14.15 MHz	28.5 MHz	50.1 MHz	144.2 MHz
RG-213 (Belden 8267)	0.810	1.501	2.035	2.687	4.305
SWR at Transmitter End	3.45	3.01	2.70	2.43	1.92
RG-8X (Belden 9258)	1.041	2.203	3.107	4.033	6.501
SWR at Transmitter End	3.21	2.64	2.28	1.99	1.50
RG-58A (Belden 9259)	1.672	3.166	4.296	5.62	9.153
SWR at Transmitter End	2.95	2.27	1.91	1.64	1.25

Table 4
SWR Seen at Transmitter End of 100 Feet of Cable Feeding a 12.5 Ω Load (4:1 SWR)

Coax Type	3.7 MHz	14.15 MHz	28.5 MHz	50.1 MHz	144.2 MHz
RG-213 (Belden 8267)	3.45	3.01	2.70	2.43	1.92
RG-8X (Belden 9258)	3.21	2.64	2.28	1.99	1.50
RG-58A (Belden 9259)	2.95	2.27	1.91	1.64	1.25

First, take and record an SWR reading of your antenna(s) with the antenna tuner bypassed (or, if need be, removed and replaced with a jumper) on all bands that you use them. For the large percentage bandwidth bands such as 80 meters, take a number of readings across the band, since they will likely be quite different. Having this data recorded and in your station log is the first step in making sure that your antennas haven't changed. Based on the discussion above, if the SWR improves over time, it is almost never good news.

Next, use *Transmission Line for Windows* (*TLW*) software to determine the actual situation on the line.[1] This is discussed briefly in the caption to Figure 1 of a recent article describing an update of *TLW*.[2] Take the measured impedance value of your antenna system at the shack end and enter it into *TLW*, but click the INPUT button, rather than the default LOAD button. If you just have SWR data and no detailed impedance information, just divide your characteristic impedance by the measured SWR and use that for the RESISTANCE value and put 0 in the REACTANCE window. Then enter the frequency, cable type, and length. The results will be very close and you will have the SWR and loss data that you would read if you measured it at the antenna. This was described in more detail in an earlier article.[3]

The data provided by *TLW* shows the actual SWR at the antenna end of the coax, as well as the total cable loss and how much is a result of any mismatch. With this information in hand, you are in a good position to understand what's really happening throughout your antenna system.

Notes

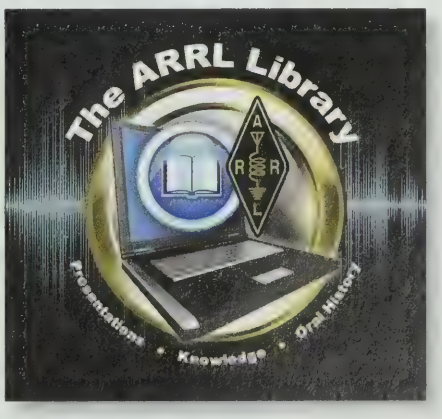
[1] *Transmission Line for Windows* (*TLW*) software is included on the CD-ROM that is supplied with *The ARRL Antenna Book*. See *The ARRL Antenna Book*, 22nd Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6948. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[2] J. Hallas, W1ZR, "Introducing an Improved Version of *Transmission Line for Windows* Software," *QST*, June 2014, pp 38 – 40.

[3] J. Hallas, W1ZR, "I Know What's Happening at the Shack — What's Happening at the Other End of my Feed Line?," *QST*, Feb 2007, p 63.

Joel R. Hallas, W1ZR, is a Contributing Editor of *QST*. You can reach him at **w1zr@arrl.org**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.



In 1953, transistors were still exotic, experimental devices, yet amateurs were already using them to generate RF power. This article by George Rose, K2AH, from the **March 1953** *issue of* QST, *introduces hams to the wonders of solid state technology.*

The Transistor—Or 25 Miles on a Hunk of Germanium

Some Background on the Tiny Devices That May Revolutionize the Electronic Art

BY GEORGE M. ROSE,* K2AH

• The first use of a transistor for transmitting purposes was reported in *QST* last month. Here the designer of the tiny rig that appeared on our February cover describes it in detail, and provides us with some basic information on transistors and their potential uses.

MOST HAMS who can qualify for the Old Timers Club remember with mixed feelings the time spent per evening searching for that elusive spot on their pet piece of galena which would bring in NAA at a readable level, if not exactly loud and clear. Neither they nor anyone else knew why or how the thing worked in the first place. When tubes finally became commercially and financially available it was the general hope that galena and its sister crystals silicon, carborundum, etc., would be properly disposed of. They did practically vanish from the electronic scene until World War II when silicon diodes were found to outperform tubes as microwave mixers. However, in some of the research laboratories scientific interest in these so-called solid-state semiconducting materials was very much alive. The usefulness of crystal diodes in military equipment intensified this interest and gave rise to some extensive research programs.

A Bit of Transistor History

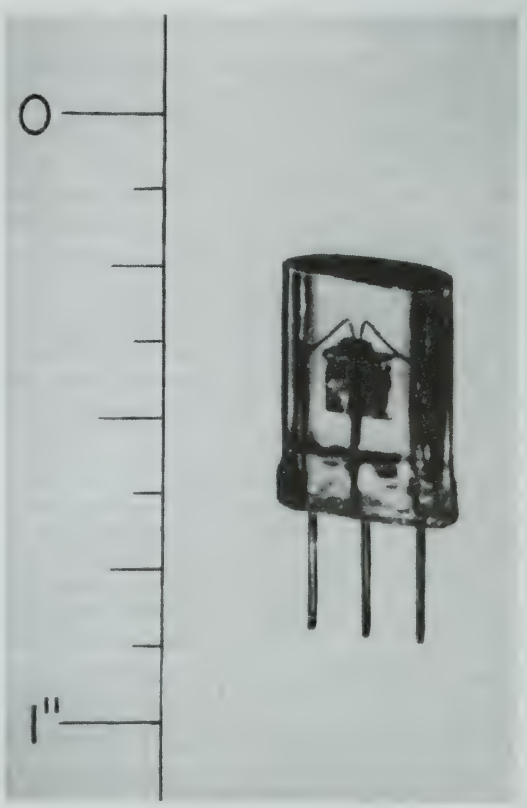
While engaged in semiconductor research at the Bell Telephone Laboratories, Messrs. Bardeen and Brattain [1] observed that if two cat whiskers were placed very near each other on a piece of germanium and current was made to flow between each cat whisker and the germanium, the two currents would react on each other. The remarkable thing was that a small change in current through one whisker would make a larger change in current through the other. This is amplification, and any electronic device which will amplify is of more than passing interest. Thus the transistor was born.

Further research showed that power amplifications of 100 times or more could be readily achieved. From this point it takes little imagination to visualize the usefulness of such a simple device; no hot cathode, very small size, and apparently nothing to wear out or get used up.

In the short space of five years the amount of scientific effort and the number of dollars spent on the transistor family has ballooned to millions of man-hours and of dollars. Even more fantastic is the fact that most of this investment is still in development rather than in production.[2] Both industry and the government are gambling on the future of the transistor, but it looks like the odds are all favorable.

The Lowest-Powered Transmitter

Now what has all this to do with the average ham? Actually nothing very much at this time,



A point-contact transistor, three times actual size.

* Manager, Advanced Developmer t RCA Tube Department, Harrison, N. J.

[1] J. Bardeen and W. H. Brattain, "Physical Principles Involved in Transistor Action," *Bell System Technical Journal*, April, 1949.

[2] B. N. Slade, "Survey of Transistor Development," *Radio & TV News*, Sept., Oct., and Nov., 1952.

except that being a person possessing more than average scientific curiosity and ability he likes to anticipate his next or next-after-next project.

The writer, being fortunately situated with respect to transistor availability, was able not only to anticipate but also to carry out a pet ham project of many months' standing. This was to generate r.f. power, no matter how small, on two meters and see if the resulting signal could be heard beyond the confines of the shack. The two-meter band was chosen for two reasons. First, K2AH has a decent antenna (12-element beam) on two meters. Second, transistors were not supposed to work at frequencies as high as 146 megacycles. Ordinary transistors do not, but we in RCA had managed to put together some special ones which oscillated not only at 146 Mc. but which continued to do so above 300 Mc.[3]

A bit of arithmetical juggling of decibels and the known outputs of several 2-meter rigs came forth with the answer that anything over about 10 microwatts in the 12-element beam would be "gravy" over a path 15–20 miles long. It worked out just that way. We were sure of 30–50 microwatts from the transistor transmitter, so it was with considerable confidence that we asked Tommy Thomas, W2UK, of New Brunswick, N. J., to listen for us at 146 megacycles. He promptly came back and reported the signal RST 559. Tommy is a bit over 25 miles away as the signal flies. We then had contacts with W2KNI, Mountainside, N. J., and with W2DPB in East Orange, N. J., both of whom are about 15 miles away. Our own QTH is Mountain Lakes, N. J.

The transistor transmitter itself was simply a keyed crystal-controlled oscillator using about the same number of incidental components as one would find in the usual tube oscillator. The circuit is shown in Fig. 1. It will seem unfamiliar because the symbol for a triode transistor is different from that of a triode vacuum tube. However, in principle the circuit is a relative of the well-known Colpitts. Another feature which is perhaps also unfamiliar is the use of the quartz crystal as an r.f. by-passing element. Crystals can be made to operate as either high-impedance or low-impedance circuit elements at closely adjacent frequencies. In this case the low-impedance mode was used so that the series resistor in the transistor base lead would be by-passed and oscillation would occur only at the crystal frequency. Next to making the transistor work at 2 meters, the pleasantest surprise came in finding it was possible to get solid frequency control at the 9th overtone of a 16-Mc. crystal which was originally maximized for 5th overtone. Control was so tight that there was no noticeable keying chirp.

Power was supplied from a hearing-aid type 22½-volt "B" battery. The series dropping resistor reduced this potential to about 10 volts at the transistor so that the total power to the oscillator was about 30 milliwatts.

We have not had the time at this writing to replace the series dropping resistor in the transistor collector circuit with a modulating transistor, but this is possible and will be done in time.

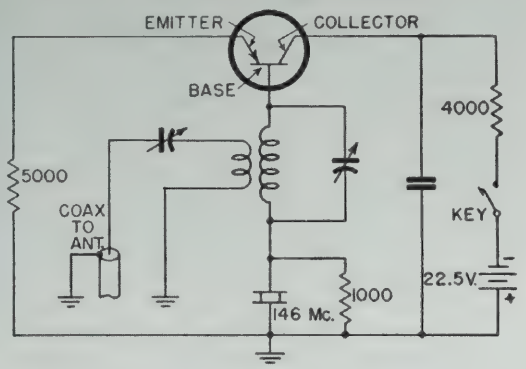


Fig. 1 — Schematic diagram of the transistor crystal oscillator used on 146 Mc. by K2AH. The only unfamiliar element is the symbol for the transistor itself. Values in the tuned circuits are dependent on the frequency used, but this general circuit works with crystals of much lower frequency as well.

Even though *Project Transistor QSO* is in the category of hobby-horse riding, its accomplishment does serve to underscore the potential importance of transistors in the field of electronics. Somewhere in the first few paragraphs we used the term "transistor family," and did so deliberately because there are already several different members. Many more will certainly be forthcoming.

Types of Transistors

The kind used in the 2-meter ham rig is a "point-contact" transistor in development by RCA consisting of two phosphor-bronze "cat whiskers" touching a small piece of germanium at points less than a thousandth of an inch apart. Germanium is a basic element and, like silicon, galena, and certain other materials, is in the class of semiconductors. These are peculiar materials in that they are neither good insulators nor good conductors.[4] They have another property which is both interesting and useful. Any metallic contact which is made to them with fairly light pressure will be found to carry current more easily in one direction than in the other, and is thus rectifying. There is as yet no good explanation but the effect seems to be a combination of electrochemical and mechanical action which disturbs the atoms of the semiconductor in the region of the contact. Well-soldered contacts do not exhibit this rectifying effect. This "disturbed" region of the semiconductor is called a "barrier" and can be thought of as a swinging door having a stiff spring on one side and a light spring on the other.

The point-contact transistor then consists of two of these rectifying contacts closely adjacent to each other on a piece of germanium. Typical

[3] G. M. Rose and B. N. Slade, "Transistors Oscillate at 300 Megacycles," *Electronics*, Nov., 1952.

[4] W. Schockley, "Electrons and Holes in Semiconductors," published by D. Van Nostrand Co., Inc., 1950.

construction is shown in Fig. 2. Of all the various semiconducting materials explored so far germanium seems to work best, so most transistor development centers around its use.

One of these contacts, called the collector, is biased several volts (sometimes as high as 30 or 40 v.) in the direction of poor conduction, so that only a small amount of current flows. Figuratively, we are trying to open the door against the stiff spring. The other contact, called the emitter, is biased a few tenths of a volt in its direction of good conduction. As this emitter bias is applied, the collector current will be observed to increase substantially and will increase 2 or 3 times as rapidly as the emitter current increases. The emitter current, therefore, reduces the effectiveness of the "barrier" at the collector contact, or in effect reduces the stiffness of the stiff spring in our door analogy. We, in effect, get a "current gain" of at least 2 or 3 times. This in itself is not very impressive, but now let us measure two other electrical properties. The input or emitter circuit resistance is found to be about 500 ohms, and the output or collector circuit resistance about 20,000 ohms. A bit of arithmetic, using Ohm's law, shows we have a power amplification of about 100, which of course "ain't hay."

So much for the point-contact transistor, except to point out something you might have overlooked. The transistor is a current-controlled device in contrast with the vacuum tube which is a voltage-controlled device. This means that transistor circuitry will be different in many respects from the familiar tube circuitry. It also means that direct performance analogies between vacuum tubes and transistors can lead to considerable confusion and should be avoided.

These remarks apply almost equally well to another type of transistor which is receiving about the same amount of technical attention as the point-contact transistor. This one is known as the "junction" transistor. It appears to be even more promising than the point-contact type, particularly at low and medium frequencies. Power gains as high as 100,000 in a single stage have already been measured. Physically the junction transistor is quite unlike the point-contact type, as can be seen from Fig. 2, although there is some similarity in principle. It, too, has two "barriers" but these are located opposite each other on or within a piece of germanium crystal.

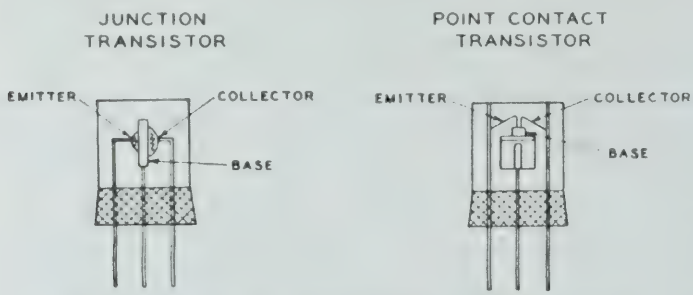
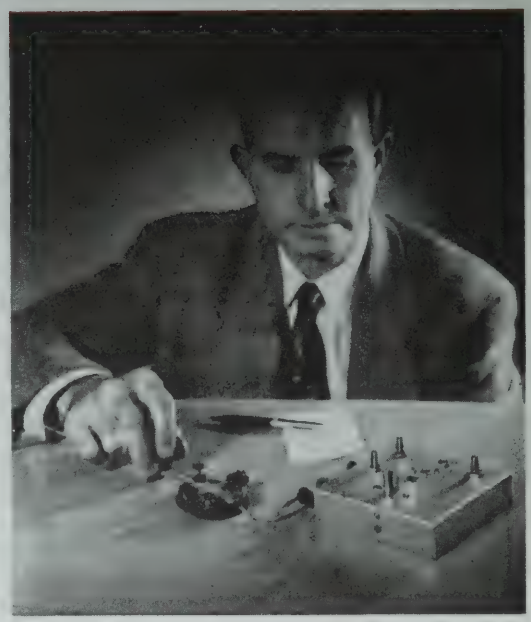


Fig. 2 — Basic details of junction and point-contact transistors.



The author and his transistor rig.

One technique for creating these barriers, or junctions, is to diffuse another material, such as the metal indium, into two sides of a small slab of germanium. Electrical connections are made as shown in Fig. 2 to each of these junctions. The third contact in both types of transistor is a nonrectifying contact soldered to the body of the germanium piece and is called the "base."

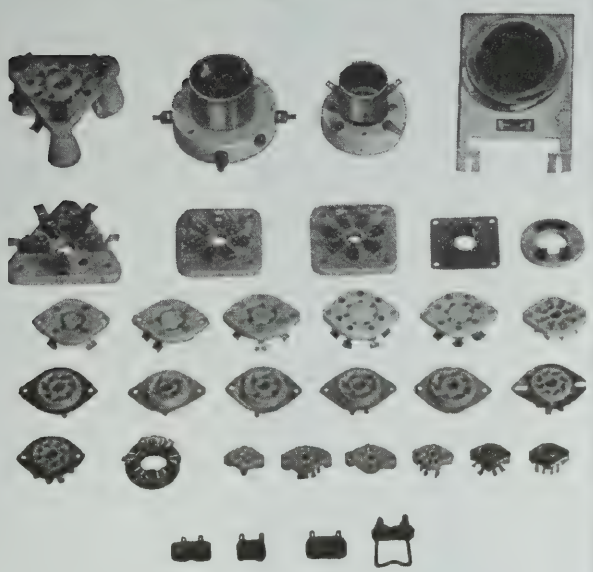
The explanation for the occurrence of power amplification in the junction transistors is somewhat less complicated than is the case with the point-contact transistor, but is still too abstruse to attempt here except to again say that the two junction areas interact. A more thorough explanation calls for the use of the concept of conduction by "holes" in addition to conduction by electrons. Holes are places in the germanium crystal atomic structure where electrons could be but are not. Although this sounds ridiculous it has considerable foundation in fact. These holes do enter into the conduction process and behave as if they were positive electrons. There is no analogous effect in vacuum tubes.

It is quite possible to make transistors in which either electron or hole conduction is predominant. One can therefore make transistors which have almost identical electrical characteristics except that the applied battery potentials are exactly reversed in polarity. It would be just as if we could make positron tubes as well as electron tubes. This is particularly intriguing to circuit specialists because it makes certain types of circuitry possible with transistors which are either impractical or perhaps impossible with tubes.

(*Continued on page 138*)

NATIONAL

• Proven
• Dependable
• Quality



COMPLETE LINE OF SOCKETS

There is a National socket made for every popular tube type and for every circuit application. All feature low-loss electrical characteristics, firm tube support and easy, secure mounting. They are recommended wherever the highest quality is required. Write for drawings and specifications.

National
©
EST. 1914
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

Transistor

(*Continued from page 15*)

They Have Shortcomings, Too

Transistors in their present stage of development have many shortcomings such as temperature dependence, certain types of instability, excess noise, and power as well as frequency limitations. The encouraging thing, however, is the fact that no one has yet been able to prove that these defects cannot be overcome in time.

The main purpose of this article is not so much to explain transistors as it is to acquaint you with the fact that there is a new member of the electronics family which is already extremely important and about which you are certain to hear more and more. Unfortunately you will probably find it virtually impossible to lay hands on transistors suitable for v.h.f. experimentation. Be patient, because the day will certainly come when you can obtain them with ease.

In honor of QST's centennial, each 2015 issue will feature an article reprinted from a vintage issue. The article reprinted here originally appeared in the March 1953 issue.

QST September 1965

Mark J. Wilson, K1RO, k1ro@arrl.org

Force 12 XR6 20 – 6 Meter Yagi Antenna

This compact Yagi packs a punch on six bands with one feed line.

Reviewed by Mark J. Wilson, K1RO
QST *Product Review Editor*
k1ro@arrl.org

In 2013, I cleared some trees and installed an InnovAntennas DESpole rotary dipole for 20, 15, and 10 meters on a decommissioned utility pole in my woods.[1] That antenna worked fine, and I made thousands of contacts with it. Last April, I installed inverted V antennas for 12 and 17 meters in preparation for operating as W1AW/1 during New Hampshire week. Again, those antennas served me well, but after a while I was hungry for more.

The Force 12 XR series of multiband Yagi antennas caught my eye. Although the XR model designator has been in the Force 12 lineup for years, the current antennas have undergone a complete electrical and mechanical redesign. (In 2013, Force 12 was acquired by the group that brings us InnovAntennas.) The new design was developed by InnovAntennas, Ltd founder Justin Johnson, GØKSC.)

The lineup includes several models ranging from the XR3 for 20, 15, and 10 meters to the XR6 for 20, 17, 15, 12, 10, and 6 meters. I picked the XR6 because I enjoy operating on all of those bands. I would be able to mount it on my utility pole using the same brackets, mast, and Tailtwister rotator I had used for the DESpole, and I could make room to turn it after clearing a couple more of those pesky trees to accommodate the antenna's 19.7-foot turning radius.

Overview

The XR6 incorporates 11 full-size elements on a 12-foot boom and uses a single feed line. It operates as a monoband two-element Yagi on each band. The 20, 17, and 15 meter Yagis use a driven element and reflector, while the 10 and 6 meter Yagis use a driven element and director. There is a 12 meter driven element, but that antenna uses the 15 and 10 meter elements for directivity rather than its own reflector or director. That's a lot of elements on such a short boom. To make the spacing work out, the 10 meter driven element is mounted on standoffs directly below the 20 meter driven element, and the 12 meter driven element is mounted on standoffs as well. The design goal was to hold pattern, SWR, and gain performance over a wide bandwidth while keeping the overall antenna compact.

Bottom Line

The Force 12 XR6 offers good performance with full-size elements on all bands from 20 through 6 meters. With its 12-foot boom, it's easy to find a spot for it when space is an issue. The quality materials and rugged mechanical design should mean that it will hold up well over time.

The XR6 boom is 2 inches OD with a ⅛-inch wall, and no support truss is required. Elements are made from high-strength aluminum tubing, and element joints are secured with rivets. All elements are insulated from their mounting brackets and from the boom using rugged Stauff clamp insulators. The feed system consists of a parallel-conductor transmission line made from square aluminum bar that is connected to all of the driven elements. Stainless steel hardware is used throughout. The assembled antenna weighs about 63 pounds.

Kurt Andress, K7NV, assisted in the mechanical design and calculated wind survival using the latest ANSI EIA/TIA-222 Revision G specifications. A detailed mechanical analysis of the antenna under various wind and icing conditions is available from the Force 12 website.

Instructions for the review antenna included a set of general instructions for XR series beams with sections specific to the XR6, a separate document covering general element construction and riveting techniques, and a third "best practices" document. Color photographs and a detailed assembly drawing are very helpful. Between the time I received the antenna and assembled it, Force 12 sent some im-

portant updates to the instructions with revised element tip dimensions, additional written assembly instructions, and more photographs. According to Force 12, a more comprehensive manual is in the works, but I didn't have any trouble using the instructions provided.

Construction

The XR6 arrived in two sturdy cartons. The boom is shipped in three pieces, with one end swaged to fit inside the adjacent section. Two ¼-inch bolts with locking nuts at each joint hold the boom sections in place. Boom-to-element brackets are factory installed and secured with multiple hefty rivets. (These elements won't be twisting in the wind as sometimes happens to elements mounted with U-bolts.) All of the insulator clamps were mounted in their proper locations. The boom is well-marked as to which element goes on which boom-to-element bracket.

Element pieces are bundled together and color-coded with tape — the tubing pieces with two pieces of red tape were the 20 meter driver, and those with one piece of red tape were the 20 meter reflector, for example. Unfortunately, the instructions did not identify which bands the different colors indicated, nor were the elements marked (20 meter reflector, 10 meter driven element, and so on). I had to loosely assemble each bundle of tubing sections and put them in order by length. According to Force 12, the new manual will have more information about element identification and the elements themselves will be marked.

Dow-Corning silicone grease and a small brush are provided to lubricate the element joints, boom joints, and stainless steel hardware. Be sure to use it — it will help keep moisture out of the joints and keep the hardware from galling.

Element sections are fastened together using closed end aluminum pop rivets with steel mandrels. The larger tubing sections use six or eight 3/16-inch rivets at each joint (Figure 1), while the smaller tubing uses six of the ⅛-inch rivets at each joint. Holes for the rivets are drilled at the factory and no measuring is required, except for the tip section. The tip sections of each element are secured with stainless steel hose clamps, but rivets are supplied to lock these down, if desired, once any final tuning adjustments are performed.

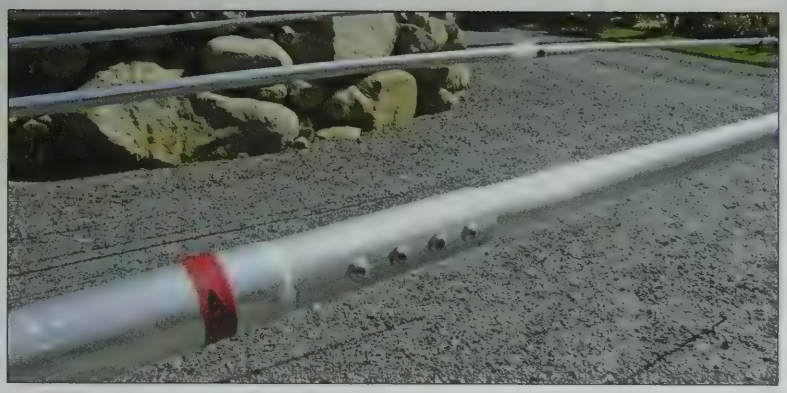


Figure 1 — Element joints use rivets to secure the sections. Element sections are well-marked with colored tape and labels.

Each element section is marked with a letter (A or B). The A and B sides are exactly the same length, but the holes for rivets didn't always line up if I failed to observe the A and B markings.

For the most part, the antenna went together easily. I started by assembling the boom and setting it on sawhorses with the elements on the top side for easy access. The XR6 mounts to the mast with elements down, but the boom is short enough that I had no trouble flipping over the finished antenna for installation.

Next I laid out the element tubing bundles in order, near their respective mounting plates, and started element assembly. I worked from the center of the boom toward the ends as recommended in the manual to distribute weight evenly. The last two elements assembled were the 20 meter reflector and 6 meter director.

For each element, first I mounted the center section loosely in its corresponding boom-to-element plate insulators. Next I assembled the riveted element sections. Those 3/16-inch pop rivets take considerable effort and hand strength to install with a standard hand tool, particularly the last squeeze just before the steel mandrel breaks off. My hands were sore for the next couple of days. I mentioned this to Chip Margelli, K7JA, at Force 12, and he suggested a two-handle riveting tool such as the "Pittsburgh Heavy-Duty 17½ inch Hand Riveter with Collection Bottle" available from Harbor Freight. That tool provides better leverage for the larger rivets. The Force 12 documentation also recommends using a pneumatic rivet tool with an air compressor, but I couldn't see buying one just for this project.

When I got to the 20 meter reflector, I found that was missing all of the 3/16-inch rivets (18 total). Force 12 sent replacement rivets and also included some new plastic spacers used to keep the ends of the closely spaced 20, 17, and 10 meter driven elements separated.

I carefully measured all of the element tips and tightened the hose clamps. I thought I was going to have to ask Force 12 for some replacement element tips, but it turned out that the 6 meter and 10 meter tips were just mismarked. The ones with pieces of colored tape that matched the driver were the right length for the director, and vice-versa.

Next, I turned my attention to the feed system, which uses two parallel square aluminum bars that connect to each driven element center with 10-24 stainless steel machine screws (see Figure 2). As with the rest of the antenna, the feeder bars were preassembled, drilled, and marked A and B. I had to fiddle with the hardware a bit to get everything lined up, but in the end it all went together smoothly.

Final assembly consisted of tightening up all of the hardware, attaching the boom-to-mast plate, and connecting the feed line. At the feed point I used the optional Force 12 EB-2 balun (Figure 3). I spaced it off the boom ¾ inch with a scrap of PVC trim left over from my house construction and secured it with some electrical tape and plastic cable ties. That way I could work on the connector with the balun secured to the boom and it shortened up the leads a little. (A sturdy balun mounting bracket is now available from Force 12 and would be a better solution.)

The instructions indicate that the boom-

Figure 2 — The 10 meter and 12 meter driven elements are mounted on standoffs below the rest of the elements on the boom. (Note that the antenna is upside down in these photos, so those elements appear to be above the boom.) The square aluminum feeder bar assembly connects to each driven element.

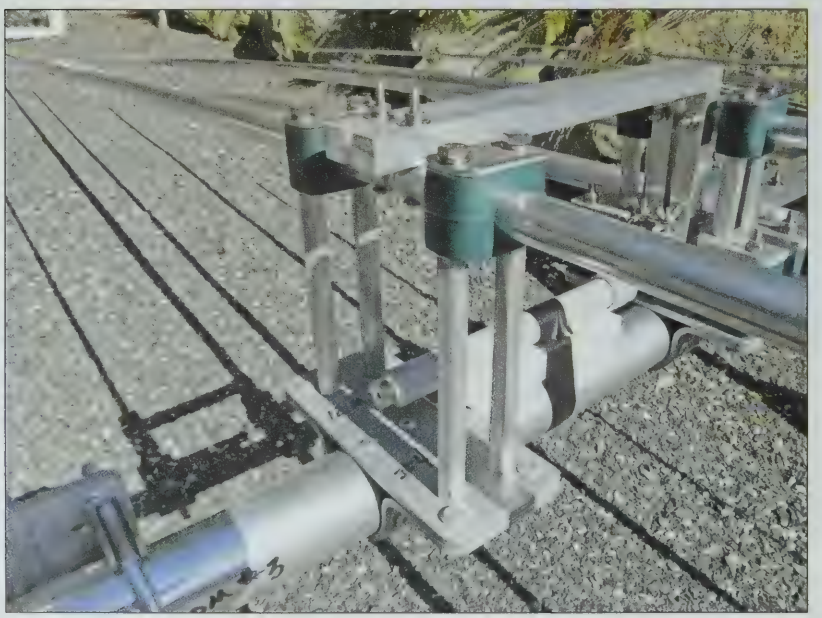


Figure 3 — The feed line connects to the balun near the center of the boom.

to-mast bracket should be placed at the physical center of the boom, not the weight balance point, and suggests adding weight to the light end of the boom if imbalance is a concern. On the tower, I have always found it much easier to handle antennas that are weight balanced, so I spent some time getting that right. I stole some 8-ounce cigar-shaped weights from my wife's adjustable ankle weight set and added them inside the reflector end of the boom one at a time until the XR6 balanced, then tacked them in place with silicone caulk. There's probably a better way to do it, but I wanted to get the antenna in the air and that's what I had handy. I found that 2 pounds of weight balanced the antenna perfectly.

The Force 12 "Easy-On" boom-to-mast mount deserves special mention. It consists of two thick aluminum plates. One plate attaches to the boom with 2-inch U-bolts, and the other attaches to the mast. The standard mast plate is drilled for 2-inch U-bolts, but plates for larger masts can be ordered. The plates have five sets of matching holes for bolts that will hold them together in the final installation. Before mounting the mast plate, a bolt is placed through the center hole such that the head is trapped between the plate and mast. When the antenna is raised, the center hole in the boom plate is mated to the protruding bolt, and a lock washer and nut installed. This holds the antenna in place while antenna is aligned and the remaining bolts are installed.

Installation

My wife, Jean, N1OJS, and I installed the XR6 on the 25-foot utility pole one sunny day in late September. I didn't have any guy wires to worry about, so it was pretty easy to get the antenna to its final resting spot. Based on experience with other Yagis on guyed towers, I suspect that the closely spaced elements at the center of the boom would make snaking it around guy wires tough. A tram system is probably the way to go. I really liked the Easy-On boom-to-mast clamp — much easier than trying to line up the antenna swinging on a rope to get U-bolts positioned.

The antenna is fed with about 200 feet of RG-213. SWR at the station end of the feed line measured 1.5:1 or less across the bands except for 10 meters and 17 meters. On 10 meters, the antenna tuned toward the top of the band, and I am most interested in the low end, so I lengthened each side of the 10 meter driver by ½ inch. That gave me low SWR at the bottom end and 1.8:1 at 29 MHz. On 17 meters, SWR was 2.3:1 at the bottom and 1.8:1 at the top. I lengthened each side of the driver by 1 inch, and now SWR is 1.9:1 at the bottom and 1.6:1 at the top. I was tired and stopped there, as it was good enough for my transmitter and amplifier. I mentioned the 17 meter SWR to Chip at Force 12 and in December he sent revised tip lengths for the 17 meter elements. I'll try that when the weather warms up.

On the Air

Listening to signals on the air, the XR6 has a good pattern, with noticeable front-to-side (F/S) and front-to-back (F/B) ratio on all bands. F/B is typically two to three S units on my TS-590S, and F/S is typically two to four S units, although signals vary from moment to moment with ionospheric conditions as well.

I was able to compare the XR6 to a multiband vertical and to inverted Vs for several bands. Signals on the XR6 are usually better than on the other antennas, sometimes by a lot. (Of course, some of that may have to do with orientation of the inverted Vs).

I used the XR6 extensively during the final months of 2014, working contests and DXpeditions and W1AW portable stations and the ARRL Centennial QSO party — some 17,000 QSOs in all, spread across 20, 17, 15, 12, and 10 meters. Although no antenna at 25 feet is going to be a band burner, I had a lot of fun with the XR6 cracking pileups, running stations at good rates, working weak stations on backscatter, and so on.

I wondered how well a tiny two-element beam would work on 6 meters. Then we had a single-hop sporadic E opening one evening, and I found myself switching back and forth between working W4/8/9 stations on 6 meters and chasing some of the W1AW portable operations on HF. With all those bands available on one antenna, band changes required little thought or effort.

The Force 12 XR6 is a good match for my needs. It covers all of the bands I'm interested in, yet is small enough to fit in the space available. After years of working with dipoles and verticals, it's nice to have a directional antenna again.

Manufacturer: RF Acquisitions International, Force 12, 566 West Crete Circle, Unit 1, Grand Junction, CO 81505; tel 888-998-8541; **www.force12inc.com**. *Price*: XR6, $1599.95; EB-2 balun, $59.95.

[1]M. Wilson, K1RO, "InnovAntennas DESpole 20/15/10 Meter Rotary Dipole," Short Takes, *QST*, Mar 2014, p 54.

MFJ-1896 6 Meter Moxon Antenna

Reviewed by Steve Ford, WB8IMY
QST *Editor*
wb8imy@arrl.org

If you're in need of directional gain on 6 meters within a relatively small footprint, a Moxon beam antenna is worth your consideration. The Moxon beam was the handiwork of the late Leslie Moxon, G6XN. It is really a two-element Yagi with the driven element and reflector about 25% smaller than a traditional Yagi. Visually, a Moxon is rather box-shaped, with the reflector element separated from the driven element with an insulating material.

The MFJ-1896 Moxon is a two-element 6 meter antenna that is only about 85 inches long and 31 inches wide. A Moxon doesn't violate the laws of physics, which is to say that it won't give you gain of a traditional Yagi antenna in such a small space, but the gain it offers is considerable, as I soon discovered.

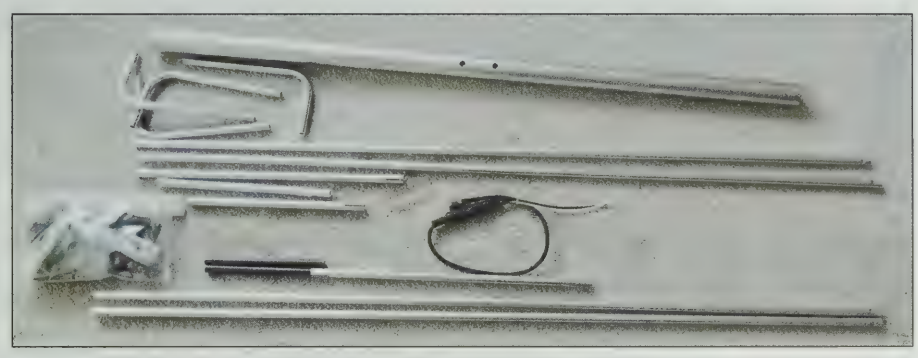


Figure 4 — The antenna arrives as a collection of aluminum tubing and a bag of fastening hardware.

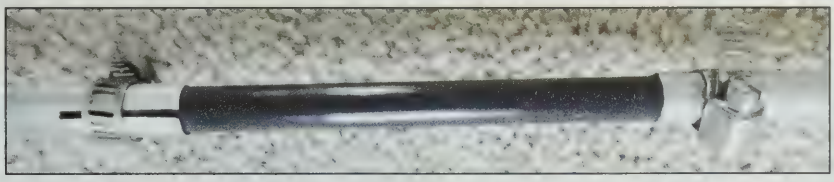


Figure 5 — The driven element and the reflector are separated by insulating material held in place by stainless steel hose clamps.

Assembly

The MFJ-1896 arrives in a narrow box with the element tubing, boom, and fastening hardware in individual plastic bags (see Figure 4). The instruction manual is well-written and illustrated, so building the MFJ-1896 is a simply matter of following the steps.

The aluminum tubing is joined through the use of tiny stainless steel hose clamps (Figure 5). I began to tighten the clamps with a flat-blade screwdriver, but the screws offered substantial resistance. After a couple of slips with the screwdriver, I grabbed my ratchet driver and it was much easier from that point onward.

Total assembly time was a little more than 60 minutes. There are a number of hose clamps to install and I kept referencing the illustration and adjusting the element lengths to maintain the desired dimensions.

The final step is to install a small balun at the feed point and secure the SO-239 coaxial "pigtail" along the boom. The kit also provides black plastic end caps for the boom and a hefty U-bolt and nuts for securing the boom to the mast.

Initial Tests

I clamped the MFJ-1896 to a 15-foot PVC pole for the initial setup, as shown in Figure 6. Sweeping the Moxon with an antenna analyzer, I discovered a low-SWR point of 1.5:1 at 49 MHz. I loosened a couple of clamps and slightly reduced the effective lengths of the driven element and reflector, being careful to make the reductions the same for both. That adjustment brought the low-SWR point up to 50.200 MHz and yielded a 2:1 SWR bandwidth from 50 to a little more than 51 MHz.

Figure 6 — The MFJ-1896 in its initial test setup.

On the Air

I placed the MFJ-1896 in a temporary setup that raised the antenna to about 20 feet above ground. That's a less-than-optimal height for a VHF beam (unless you live on a hilltop!), but the results were immediate. The first afternoon, I enjoyed a conversation with a station in Pennsylvania, about 200 miles away. He gave my 100 W SSB signal a "solid 5-9." Best of all, he was happy to indulge me as I shifted the antenna in various directions. The directional pattern wasn't particularly sharp, but it was definitely noticeable.

By coincidence I was testing the MFJ-1896 during the November Leonid meteor shower. Using the FSK441 mode in the *WSJT* software suite, I was able to complete a number of meteor scatter contacts. Again, the directional characteristics were a big plus. I was able to rotate the MFJ-1896 and take advantage of scatter propagation that targeted certain areas of the United States (those areas that contained grid squares I needed for my VHF/UHF Century Club award).

I was highly impressed with the MFJ-1896 Moxon. For an amateur like me, with limited antenna space, this antenna is a godsend. It is affordable, well-designed, and lightweight. An ordinary TV antenna rotator will easily support this Moxon. In fact, chances are your neighbors will think it *is* a TV antenna.

Manufacturer: MFJ Enterprises, 300 Industrial Park Rd, Starkville, MS 39759; tel 662-323-9715; **www.mfjenterprises.com**. *Price*: $69.95.

Cubex Mosquito-6 70 cm Quad Antenna

Reviewed by Steve Ford, WB8IMY
QST *Editor*
wb8imy@arrl.org

The Cubex Mosquito-6, as the name implies, is a six-element quad antenna designed for use on the 70 centimeter band from 430 to 450 MHz. At just 2 pounds, the Mosquito-6 is lightweight and the fiberglass boom is only 32 inches in length. The square wire elements give the antenna a compact profile and a turning radius of just 38 inches.

Assembling the Mosquito-6

The Mosquito-6 arrives in a multi-section plastic bag. One section contains a heavy duty steel antenna mounting plate with accompanying U bolts and nuts. You aren't obligated to use this plate. In fact, I mated the boom to a PVC T section and an adjoining PVC mast for portable use. For permanent mounting, however, the rugged plate is best.

Assembling the Mosquito-6 required about an hour of careful work, although with practice I'm sure the process would go much faster. You have to insert the spreader arms according to the color codes (Figure 7), apply the rubber "keepers," and then string the element wires through the "nocks" at the ends of the arms. Each element ends up being bent slightly backward under tension toward the end of the boom, but not to worry. This is intentional and the arms are flexible, yet tough.

Figure 7 — The spreader arms are color coded. All you have to do is match the color of the arms to the colors indicated on the boom.

You need to provide a short length of coax to attach to the feed point block (Figure 8). This involves stripping off the coaxial cable insulation, separating the braid and center conductor, and then soldering eyelets onto each. The eyelets, in turn, are secured to the block with small stainless steel nuts. The block then attaches to the driven element at the ends of one of the spreader arms, depending on the polarity you desire.

I swept the finished antenna with an analyzer and measured a minimum SWR of 1.4:1 at 430 MHz, which gradually rose to about 2.5:1 at 450 MHz. Repositioning the feed point block slightly will allow limited tweaking for the lowest SWR at your desired frequency. Figure 9 shows the finished antenna.

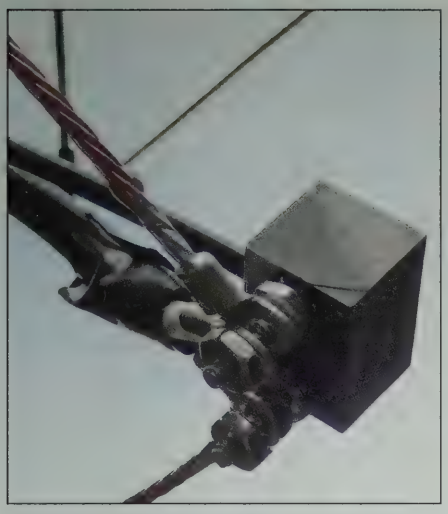


Figure 8 — A close-up view of the feed block at the end of the spreader arm.

Figure 9 — Eavesdropping on the OSCAR 50 satellite with the Cubex Mosquito-6.

Performance

In both terrestrial and satellite use, the Mosquito-6 exhibited quite "focused" behavior. While receiving amateur satellite downlinks around 436 MHz, for example, moving the antenna just a foot or two was sufficient to noticeably degrade the signal.

The Saudi-OSCAR 50 satellite has a somewhat weak FM downlink, but with just a handheld transceiver I had little difficulty monitoring conversations while aiming the antenna by hand. During one pass I was occasionally seeing 10 dB over S9 signals with OSCAR 50 at just 28 degrees above the horizon. This was *without* the use of a receive preamp.

I managed to scare up a couple of terrestrial SSB contacts with the Mosquito-6 mounted on a 20-foot mast in my back yard and received good reports. Once again, the sharp pattern of the antenna was obvious. During one conversation I decided to really put the Mosquito-6 to the test. I moved the antenna into my attic and fed it directly from my transceiver with just 50 W PEP. My friend at the opposite end of the path, about 30 miles away, noticed a slight reduction in strength, but said that my signal was otherwise solid.

The Yagi Alternative

The Cubex Mosquito-6 offers a light, compact alternative to traditional 70 centimeter Yagi antennas. Despite its wire construction, I have a feeling the Mosquito-6 would hold up well in most weather conditions. As the instruction sheet advises, it is a good idea to apply some protective putty to the exposed portions of the feed block if you tend to use the Mosquito-6 in a permanent installation.

Manufacturer: Cubex Quads, PO Box 352, Alto, MI 49302; tel 616-622-4968; **www.cubex.com**. *Price:* $73.

HobbyPCB Hardrock-50 Internal Automatic Antenna Tuner

Reviewed by Phil Salas, AD5X
QST *Contributing Editor*
ad5x@arrl.net

The HobbyPCB Hardrock-50 amplifier I reviewed in the December 2014 issue of *QST* did not include the optional internal autotuner as it was not available during the review period.[2] The HR50-ATU is now available, and a review of its performance seemed to be in order. It's especially attractive because the optional module can be used as a standalone QRP broadband wattmeter and autotuner when the Hardrock-50 amplifier is bypassed.

The Kit Build

Like the Hardrock-50 amplifier, the HR50-ATU is available only in kit form. Assembly entails installing the inductors, transformer, ICs, and connectors on the printed circuit board. Surface mounted (SMD) components are pre-installed. Figure 10 shows the complete kit of parts.

Bottom Line

The HR50-ATU mounts within the Hardrock-50 amplifier and provides automatic tweaking of less-than-perfect antenna systems.

The bag of parts in the upper left is the retrofit kit needed for Hardrock-50 amplifiers below serial number 1400. These early amplifiers require some SMD capacitor changes if 60 meter operation is desired. Also, the dc connector must be replaced

Table 1
HR50-ATU Antenna Tuner Kit

Manufacturer Specifications

Frequency range:	All amateur bands from 160 – 6 meters.
Autotune power:	1 W minimum, 50 W maximum.
QRP mode power:	20 W relay switched, 5 W optional PIN-diode switching.
Tuner configuration:	Series-L/shunt-C, reversible-L matching network.
L/C tuning ranges:	0 – 1300 pF in 128 steps; 0-6.4 µH in 128 steps; relay switched.
Matching range:	Up to 10:1 SWR at 50 Ω. Lower on 160 and 6 meters.
Target tuned SWR:	Typically 1.5:1 or better.
ATU memory segments:	Non-volatile storage of up to 343 tuning solutions. 10 kHz wide segments from 160 – 12 meters (233 solutions), 25 kHz wide segments on 10 meters (69 solutions), and 100 kHz wide segments on 6 meters (41 solutions).

Price: $179.

Resistive Load and Loss Testing

SWR	Load		160 m	80 m	40 m	20 m	10 m	6 m
10:1	5 Ω	Loss (%)	61	51	46	10	17	31
		SWR	5.8	4.6	3.8	1.12	1.08	1.13
8:1	6.25 Ω	Loss (%)	52	17	13	7	11	15
		SWR	4.8	1.83	1.72	1.06	1.17	1.24
4:1	12.5 Ω	Loss (%)	25	4	4	3	7	13
		SWR	2.71	1.3	1.17	1.15	1.17	1.53
3:1	16.7 Ω	Loss (%)	15	2	2	3	7	11
		SWR	2.1	1.18	1.17	1.20	1.19	1.09
2:1	25 Ω	Loss (%)	4	1	1	2	5	10
		SWR	1.49	1.15	1.06	1.22	1.06	1.17
1:1	50 Ω	Bypass Loss	0	0	0	0	0	0
		Bypass SWR	1.05	1.05	1.05	1.06	1.06	1.21
2:1	100 Ω	Loss (%)	2	3	4	4	6	16
		SWR	1.12	1.09	1.22	1.17	1.30	1.50
3:1	150 Ω	Loss (%)	9	4	5	6	10	20
		SWR	1.64	1.13	1.13	1.29	1.30	1.29
4:1	200 Ω	Loss (%)	20	5	7	7	11	23
		SWR	2.13	1.05	1.08	1.29	1.21	1.58
8:1	400 Ω	Loss (%)	42	10	8	8	14	39
		SWR	3.89	1.51	1.39	1.14	1.32	2.24
10:1	500 Ω	Loss (%)	51	15	10	10	20	56
		SWR	5.0	2.0	1.40	1.16	1.24	2.57

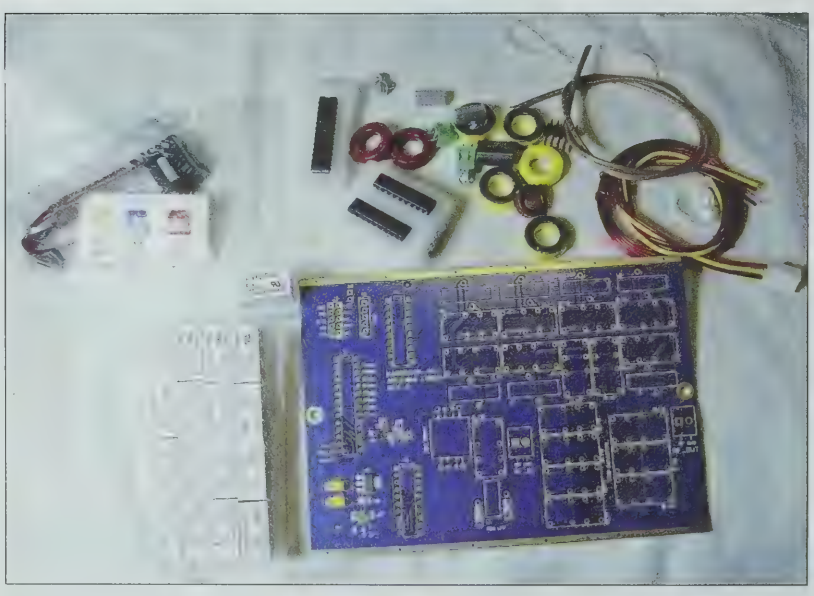


Figure 10 — The HR50-ATU kit as received. The 4 x 5.5 inch PC board includes top and bottom side pre-mounted SMD components. Toroids and the transformer must be wound according to instructions in the manual.

and the chassis drilled for autotuner mounting. I won't discuss the retrofit/upgrade as this is well-documented in the HR50-ATU assembly manual. And all Hardrock-50 amplifier kits ordered after about mid-November 2014 include these updates.

The HR50-ATU kit includes no documentation, so you must download the assembly manual from **www.hobbypcb.com**. Rather than print out the manual, I found it convenient to display the pages on a laptop computer adjacent to my assembly area.

Assembly was easy — and much less time-consuming than the assembly of the Hardrock-50 amplifier. Winding the inductors and transformer took about one hour and was not difficult thanks to the clear instructions and color illustrations. If you like, you can purchase the inductors and transformer pre-wound from **toroid guy@earthlink.net**. Another 1.5 hours were required to complete the full assembly. Figure 11 shows the completed HR50-ATU PC board.

The HR50-ATU mounts inside the bottom cover of the Hardrock-50 amplifier and connects to the amplifier with two coax cables and a three conductor cable. It takes about 30 minutes to mount the HR50-ATU in the amplifier. So the total time for build and installation will be approximately three hours. Upon completion, verify that you have the latest Hardrock-50 amplifier and HR50-ATU firmware and update if necessary.

In addition to providing the autotuning function, the HR50-ATU adds the filtering necessary for 60 meter operation of the Hardrock-50 amplifier. When the Hardrock-50 amplifier detects the presence of the HR50-ATU, it permits 60 meter band selection. And as mentioned in the introduction, the HR50-ATU can be used with the amplifier bypassed to provide both a QRP power meter and a standalone autotuner for QRP radios. Table 1 lists the HR50-ATU specifications.

HR50-ATU Operation

When the HR50-ATU is installed in the Hardrock-50 amplifier, menu 10 selects either the BYPASS or ACTIVE mode. BYPASS fully bypasses the HR50-ATU with a relay. When ACTIVE, the HR50-ATU monitors data received from a transceiver, a computer, or the Hardrock-50 band information, and applies previously stored tuning

Table 2
QRP Power Display Accuracy

HR50-ATU Display with 2 W Applied

Band (M)	Original (W)	Error (%)	Corrected (W)	Error (%)
160	1.4	–30	1.7	–15
80	1.4	–30	1.7	–15
40	1.6	–20	1.8	–11
30	1.6	–20	1.9	–5
20	1.7	–15	1.9	–5
17	1.7	–15	2.0	0
15	1.7	–15	2.0	0
12	1.7	–15	2.0	0
10	1.7	–15	1.9	–5
6	1.6	–20	1.9	–5

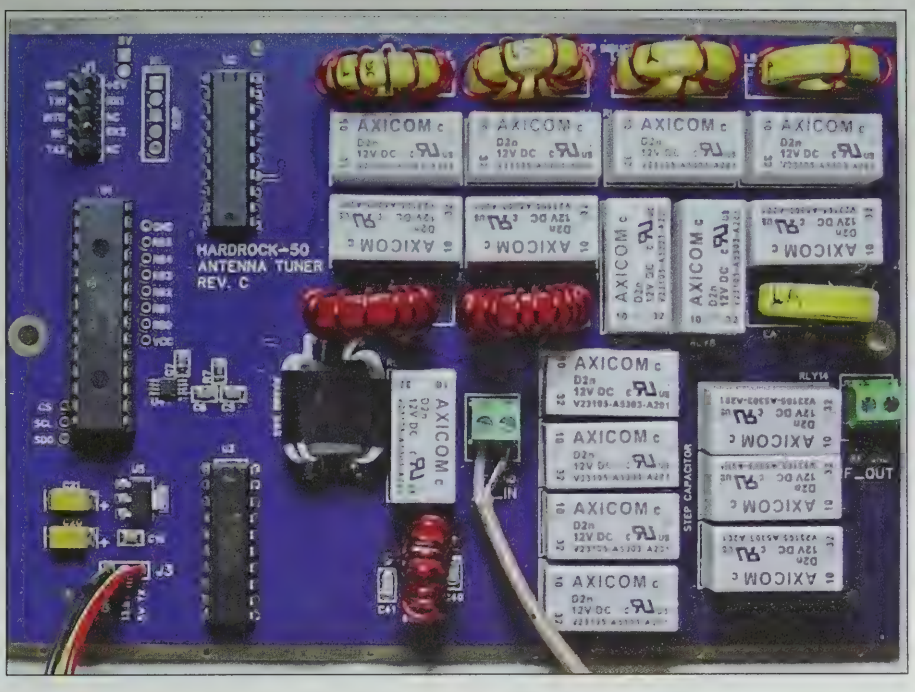


Figure 11 — Assembled HR50-ATU ready for installation in the Hardrock-50 amplifier.

solutions prior to transmitting. When ACTIVE, the HR50-ATU can be bypassed by pressing the – button while transmitting. To restore the ACTIVE mode, press the + button while transmitting.

When band data is avilalable only from the Hardrock-50's internal band information, the last tuning solution for that band is applied. If more precise frequency data is received from a transceiver or computer, the last tuning solution stored for that frequency is used. If no frequency information is found, the last tuning solution for that band is used. And if no tuning solution is found for that band, the HR50-ATU is bypassed but remains ACTIVE. The HR50-ATU does not measure frequency directly, eliminating the possibility of false memory selections caused by errors in counting a modulated frequency.

The HR50-ATU tunes only when the operator requests a tune, and so there is no SWR trip-point to automatically start a tuning cycle. A high SWR condition will not damage either the HR50-ATU or the Hardrock-50 amplifier, so no automatic amplifier bypass occurs under a sudden high SWR condition. This also protects the driving transceiver from damage as the in-line Hardrock-50 amplifier provides a good 50 Ω termination.

Tuning is initiated by pressing the MODE button while transmitting. This bypasses the amplifier, tunes, stores the tuning information in memory for that band or frequency, and re-engages the amplifier. The HR50-ATU responds to a wide input power range and can tune with a constant signal, a string of CW characters, or even SSB audio. Tuning is fast, typically requiring less than 1 second. If the target SWR cannot be achieved, tuning stops after 4 seconds and the lowest SWR match is applied.

Tuner Matching and Loss Measurements

I performed resistive matching range and loss testing with the precision setup described in the August 2012 issue of *QST*.[3] The test results are given in Table 1. Tuning power was 2 W and all measured losses are subject to the ±3% accuracy of the calibrated test equipment used.

As you can see, the HR50-ATU achieved its 1.5:1 or better SWR target except for some extreme matching conditions on low and high bands. As with all tuners, HR50-ATU losses increase as SWR increases. Keep in mind, however, that matching a high SWR at the station end of your antenna system can result in even higher SWR-related coax losses.

Open/Short Circuit Testing

Ideally, a tuner should not be able to match an open or short. If it does, this means that it is tuning into its own internal losses and the tuner may be damaged as it is dissipating full transmit power. No antenna tuner is lossless because of the finite-Q components used, and so most wide-range antenna tuners can find a match on one or more frequencies when connected to an open or a short.

I found one instance on 15 meters where the HR50-ATU successfully tuned into a short. Tuning failed on all other bands with the short, and tuning failed on all bands with an open.

Of course, you should always check the bypassed SWR prior to tuning, and if it is beyond the capability of the tuner (10:1 SWR in this case) the antenna system needs to be improved. While this doesn't preclude a sudden SWR change caused by an antenna system component failure, the HR50-ATU does not tune unless requested by the operator. Therefore any sudden change in the antenna system would show up as a high SWR, which can then be resolved.

QRP Power Meter Testing

The Hardrock-50 amplifier provides accurate RF power metering at close to full output power after calibration. However, the wattmeter display is active only when the amplifier is keyed, and it is quite inaccurate a low power levels. The QRP/Wattmeter mode of the HR50-ATU provides a standalone wattmeter display with improved power readings at the lower power levels. I made power measurements at 2 W with a calibrated power sensor and recorded the HR50-ATU displayed power. Originally, the power readings were all low. However, like the Hardrock-50 amplifier, the HR50-ATU

firmware provides an offset setting for improved accuracy. I re-measured the power readings after I set an offset of +20%. Table 2 characterizes the test results at 2 W.

Operating

I interfaced my Elecraft KX3 transceiver to the Hardrock-50 amplifier/HR50-ATU with a cable that provides frequency information. My HF antenna is a 43-foot vertical with the remote 160/80 meter matching unit described in the January 2010 issue of *QST*. Once I memorized tuning solutions for the vertical on all HF bands, operation was a breeze as the HR50-ATU followed my KX3 and picked the correct tuning solution prior to transmitting.

Conclusion

The Hardrock-50 internal ATU provides all the antenna system flexibility most hams will need. The HR50-ATU kit is reasonably priced, and the kit is not difficult to build. If you don't have a perfect antenna system, the HR50-ATU may be a worthwhile addition to your Hardrock-50 amplifier.

Manufacturer: HobbyPCB, tel 646-580-4722; **www.hobbypcb.com**.

[2]P. Salas, AD5X, "HobbyPCB Hardrock-50 160 – 6 Meter 50 W Amplifier Kit," Product Review, *QST*, Dec 2014, pp 44 – 47.
[3]P. Salas, AD5X, "MFJ-994BRT and MFJ-998RT Remote Automatic Antenna Tuners," Product Review, *QST*, Aug 2012, pp 47 – 50. See the digital edition of that issue or **www.arrl.org/qst-in-depth** for details.

bhi Desktop Amplified DSP Noise Cancelling Speaker

Reviewed by Joel R. Hallas, W1ZR
QST *Contributing Editor*
w1zr@arrl.org

The bhi Desktop is the size and shape of many compact stereo speakers and will fit nicely on many an operating desk. If the DSP function is turned off, it will act just like many other amplified two-way speakers with its 4-inch bass driver and 1-inch tweeter and VOLUME control. Switch on the DSP filtering and you get your choice of eight noise reduction and automatic beat or heterodyne reduction levels. With an input level of 350 to 3500 mV_{P-P} from your radio speaker jack (or a line level input of 160 to 1600 mV_{P-P}), it can supply up to 10 W output, making it a good companion for some compact and DSP transceivers that don't provide speaker level audio.

What it Does

While the bhi Desktop looks like a bookshelf high-fidelity speaker, the manufacturer warns that it is designed to reproduce speech, not music. I believe that is more a function of the processing than about the speaker itself, but if you are after an entertainment speaker, there are many less expensive choices out there that don't offer the noise reduction possibilities.

The speaker has a coaxial type power jack for the dc supply, perhaps provided by an accessory output from your radio. It requires 12 to 18 V dc at typically 125 mA, but is specified at up to 2.5 A peak, possibly pushing the limits of many radio accessory power sockets. A cable is provided with a matching plug for the speaker end and bare wires on the other end, ready to be set up with the appropriate connector for your power supply. The cable includes an in-line fuse.

The audio input connections are provided by a pair of terminals that can accept banana plugs, spade lugs, or even bent wires. A cable is provided that has banana plugs on one end and a 3.5 millimeter mono phone plug on the other. A separate LINE LEVEL input uses a 3.5 millimeter stereo jack that can accept mono or stereo signals. Stereo signals are electronically combined into a mono signal before processing.

The unit may be used as a table-top speaker, or an included bracket can be used for wall or under-shelf mounting. Select your mounting location so that the right side panel is within reach, so that the controls can be easily manipulated.

Noise and Tone Reduction

The bhi Desktop is specified to reduce tones by 4 to 65 dB in eight steps while it simultaneously reduces noise by 9 to 35 dB. There is no provision to perform the functions separately.

Bottom Line

The bhi Desktop Speaker delivers the goods in both noise reduction and tone elimination. If your receive or transceiver doesn't provide these functions, you will likely find this upgrade worthwhile.

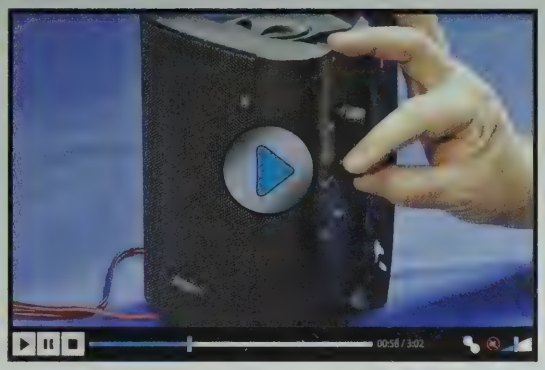
The unit has two controls. Both controls are combination level controls and push button ON-OFF switches. The VOLUME knob adjusts the level of the speaker or connected headphones and includes a toggle push on-off POWER function. If the unit is powered on, a multicolor LED indicator is illuminated. There is no pass through with the power turned off.

The FILTER knob provides DSP level adjustment in eight steps. Pushing the FILTER knob turns the DSP processing on (multicolor LED turns green) or off (red). The unit emits variable level beeps to signal each cycle step, providing the operator feedback on the amount of processing selected.

The documentation doesn't say much about how and how quickly the noise reduction attacks and cancels tones, so I was initially concerned to see if it would cancel out CW signals, a phenomenon of some of these devices in tone cancellation mode. I found that it seemed to take several tenths of a second for cancellation to occur, allowing normal-speed CW to pass through without problems. Of course this may be viewed differently by a phone operator, who may want instantaneous noise reduction. It also makes it a bit difficult to decide which level of reduction you want, since the attenuation takes some time to complete processing after you have selected a level.

Note that there are multiple combinations of the radio and speaker VOLUME controls that can provide any desired speaker (or headphone) output level. If the drive signal to the speaker system is too high an OVERLOAD indication is reportedly provided by the LED changing from green to red and flashing three times. I couldn't get enough output from my receiver to cause the overload indication, but at high radio volume clipping and distortion were evident. Low audio from the radio may be more difficult to identify, but if there isn't enough signal level into the processor analog-to-digital converter, it won't have enough dynamic range to completely perform the processing. The input level sweet spot seems quite wide, but be aware that it needs to be taken into account. I found good performance with the radio level set to comfortable volume before connecting the DSP.

Even though the documentation doesn't discuss the tone reduction, its capabilities



See the Digital Edition of *QST* for a video overview of the bhi Desktop Amplified DSP Noise Cancelling Speaker.

are quite good. While I could only generate a single tone in the passband, which the reduction removed very nicely, I found some complex multi-tone warbling signals that the tone reduction also eliminated. It took the processor about 1 second to eliminate a single tone and 2 seconds to eliminate two or three. It was effective against multiple tones of similar amplitude, as well as tones of different amplitude. This could be very handy all by itself.

How it Plays

With no processing, this speaker sounds better to me than internal speakers in most radios, and perhaps even better than the compact bookshelf speakers that I use with my main and sub-receivers.

Both the white noise reduction and tone reduction functions definitely work. I compared the noise reduction to the single choice NR function of a high-end transceiver I was testing, as well as the multiple levels found on my usual transceiver, and found the capabilities generally comparable. If your radio offers built-in DSP noise and tone reduction, any improvement will likely be small. On the other hand, if your radio doesn't include these features, this would make a significant improvement in capability.

In evaluating the unit, I found that if the signal were strong to start with, so the noise (due to AGC action) was fairly low, the different reduction levels didn't sound very different. It took a weak broadcast station with a low signal-to-noise ratio, to convince me that each additional level made additional improvement. As with all DSP systems that I've encountered, the additional levels also brought additional artifacts and distortion, mostly noticeable in the top two or three levels. Interestingly, the artifacts were most noticeable if there was just noise present — appearance of a signal seemed to make them much weaker. The improvement clearly could make the difference between being able to understand a voice signal or not. It's also important to wait a fraction of a second at each step before deciding how well it is helping, since it takes a bit for the speaker to adjust the processing to the new level. This also seems to happen more at the higher levels than at the lower levels that have less processing.

Documentation

The unit comes with an eight-page instruction booklet that does an adequate job of describing the speaker and how to use it. It also briefly describes the noise reduction function, but assumes you understand what tone reduction is all about. Perhaps if you didn't, you wouldn't buy it. The manual provides troubleshooting and support information and a set of Frequently Asked Questions. I think it will meet the needs of most users.

Manufacturer: BHI Ltd, PO Box 318, Burgess Hill, West Sussex RH15 9NR, England; tel +44 (0)1444 870439, **www.bhi-ltd.com**. Available in the US from GAP Antenna Products, 99 North Willow St, Fellsmere, FL 32948; tel 772-571-9922; **www.gapantenna.com**, and W4RT Electronics, 3077-L Leeman Ferry Rd, Huntsville, AL 35801, **www.w4rt.com**.

Feedback

■ In "A Solid State 1.25 kW Linear Amplifier" by Andrew J. Buckler, K2OP, that appeared in the January 2015 *QST*, there is an error in the diagram of the HF+Six amplifier deck (Figure 3). The anode of the Zener diode should be grounded, as should the adjacent 22 pF capacitor, 150 Ω resistor and the bottom of the primary winding of T1.

Joel R. Hallas, W1ZR, w1zr@arrl.org

Roll Up Your Sleeves and Make a Sleeve Dipole

Q Jared, KC2MM, asks: I came across an antenna design that the author called a "vertical bazooka." This is an antenna made by folding the shield of a coax cable back ¼-wavelength over the outside of the cable, and leaving ¼-wavelength of the center conductor extending out, effectively making a center-fed dipole that is physically end fed (see Figure 1).

I remember seeing this type of antenna in an old *ARRL Antenna Book*, but it had a different name. I also wonder about the fact that the author applied the coaxial cable propagation velocity factor to the sleeve conductor length, but that doesn't seem appropriate. Can you shed some light on this?

A That type of antenna was popular for many years as a vertical polarized VHF mobile antenna. It was the standard antenna used on the early AT&T MTS (mobile telephone service, c. 1950s – 70s) that operated in the 150 MHz range. It was generally referred to as a "sleeve dipole," or sometimes as a "coaxial dipole." In the MTS implementation, as well as many others, instead of using the shield itself, there was a separate metal tube for the sleeve, surrounding an inner metal tube that served as the mounting mast and enclosed the feed cable.

The arrangement using the coax cable shield has also been used as an HF vertical or horizontal dipole, although it can be a chore to pull the longer length of shield back, depending on the coax type.

One of the limitations of a sleeve antenna is that there is strong coupling between the sleeve and the outside of the coax feed line at the bottom of the sleeve, resulting in large common mode current on the outside of the transmission line. This can be reduced by the choking action of the outer sleeve, as well as additional choking below the bottom of the sleeve, but the intense field at that point tends to couple around the lower choke, requiring another choke further down the coax.

I looked at the design you referenced, and the author indeed made an error in his dimensions. He suggests using the velocity of propagation of the coax to determine how much to reduce the length of the sleeve made of the folded back shield. This is not quite correct. That coax velocity factor applies to signals within the coax in differential mode, based on the dielectric property of the insulation between the center conductor and the shield. This factor does not apply to the use of the coax shield as an antenna.

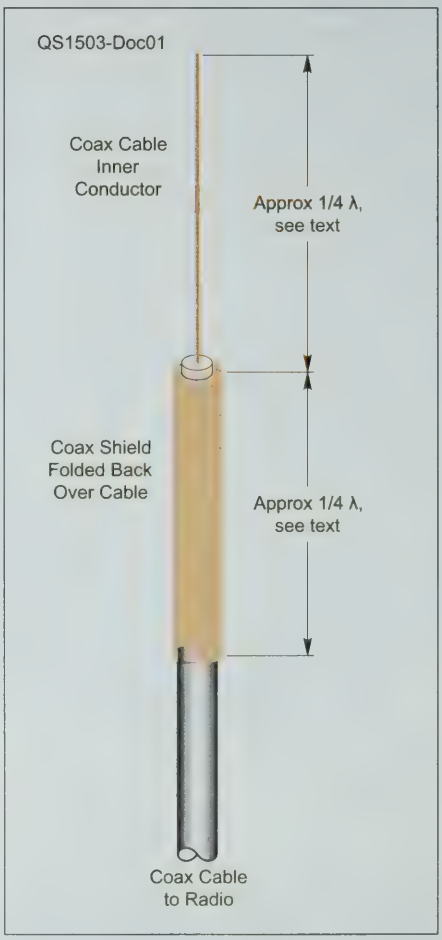

QS1503-Doc01
Coax Cable Inner Conductor
Approx 1/4 λ, see text
Coax Shield Folded Back Over Cable
Approx 1/4 λ, see text
Coax Cable to Radio

Figure 1 — A *sleeve* vertical dipole made from a length of coaxial cable. This is easy to make and handy for a vertical because the feed comes from the bottom. As noted in the text, unless eliminated, there will be coupling from the sleeve to the coax feed, resulting in common mode current headed toward the station.

There is a subtle effect to consider here (thanks to Kai Siwiak, KE4PT). There are actually two different functions performed by the sleeve. The outside of the sleeve acts as the lower half of the dipole, as expected. The system consisting of the inside of the sleeve and the outside of the coax inside it act to signals on the coax shield as a shorted transmission line section. If that section is an electrical ¼-wave long, it will have a high impedance and act like a common mode choke (often called a *bazooka* — hence your published design's name) to signals on the outside of the coax — a good thing.

The subtlety of the design comes about because the bazooka is acting like a transmission line, but its dielectric is a mix of air and the coax outer jacket, so the electrical ¼ wave there does want to be shorter than that of the outside of the same sleeve. Obviously, it can only be one length and if made the right length for the bazooka, it will be too short to be half a dipole. Thus the upper part of the dipole would then need to be extended to make it resonant. It will now be somewhat off-center fed.

The challenge then is to first make the bazooka the optimum length for best choking and then adjust the top of the dipole for minimum SWR. Measuring the electrical length of the bazooka could be done with an antenna analyzer connected between the coax shield and the open end of the sleeve with the other end shorted. The frequency with the highest impedance is the bazooka frequency.

If the bazooka is not properly set up, the antenna will still radiate, but the common mode signal on the coax will need to be choked off entirely below the antenna.

[1]Notes appear on page 65.

Q Farncomb, VE3BHQ, asks: I am refurbishing my rotary beam antenna, a wide-spaced, full-size, three-element 20 meter Yagi, with an interlaced four-element 15 meter wide spaced beam on the same boom. It is now necessary to replace the coax transmission line. In the past I have used two separate coax lines, one to each beam. However, in order to save coax and simplify the system, what would happen if I only used one transmission line that provided a parallel connection to the gamma match of each beam?

I have discussed this with another amateur who feels that this would work fine, since the RF signal would feed into the resonant antenna. What do you think?

A Unfortunately, your friend's solution is not sufficient to achieve the results you seek. Yes, both antennas act as 50 Ω loads on their bands, but the real questions are: what is the impedance at the 20 meter gamma match on 15, and what is the impedance of the 15 meter gamma match on 20? Those impedances will be transformed by the coax cable going to the T connector at which point they will be in parallel with the 50 Ω load of the desired antenna. Depending on the resulting impedances, the power will split between the antennas in ways that can only degrade the nice patterns you have been enjoying.

If you could measure the impedances at the antenna on the alternate bands, I could use *TLW* to see if there is a length of coax from each antenna that will result in a very high impedance at the T connector on the alternate band, otherwise significant power will likely end up in the wrong antenna.[2]

I have not had much luck modeling gamma matches to predict how this would work, but even if I did, chances are that your real antenna would be somewhat different. So, in summary, it indeed may be possible to connect the antennas in parallel, but it is not a trivial matter to define the cable dimensions to actually make it work.

Another possibility is to use a remote coax switch, such as the two-position Array Solutions Rat Pack or four-position Ameritron RCS-4, that can switch up to four coax-fed antennas and runs the dc switching power up the single coax, along with the signal. Array Solutions also offers switches with more positions and dc on the coax. It may cost less than a second coax run, and could also support a lower band inverted V and another Yagi, all over the same coax run.

Q Bruce, N1EQG, asks: First, I remember that you wrote an article about using a transceiver with dual receivers. I can't find it and would appreciate a pointer. Second, I see multiple transceivers that offer a dual receive function, but none that offer dual receive and dual transmit capability. Are there any that can do both?

A The article you are looking for was likely a part of my "Getting to Know Your Radio" series from 2007.[3] This is available in the ARRL website's "*QST* Print Archive."

My usual transceiver includes a second receiver option, and it works well. I can work DX with the DX station in one ear, and the stations calling on a different frequency in the other — the easiest way I know of for working split frequency DX. Of course, this requires two working ears and stereo phones or speakers to make it beneficial.

Within each brand there are some that have dual receivers and some that don't. For example, in the Elecraft K3, the second receiver is available as an option that can be added at any time. The new FlexRadio transceiver line has the possibility of even more receive channels. The Hilberling PT-8000 has dual receivers. From Icom, the IC-7800 has a dual receiver, while the IC-7700 does not. The IC-7600 includes a "dual watch" function that receives on two frequencies simultaneously, but they both appear in a single audio channel. If you only have hearing in one ear, it's all you can make use of. From Kenwood, the TS-990 has dual receive, the TS-590 does not. Yaesu has dual receivers in the FT-2000, and in the FTDX-5000 and up.

I'm not aware of a radio that has dual transmitters, but I'm not sure why you would want to transmit on two frequencies at once (unless you are W1AW, sending code practice). You can quickly change transmit frequencies (for instance, switch between memories on one channel) and still listen on the other band, for example, in most but not all of those radios — perhaps allowing you to do what you want?

The Hilberling PT-8000 I recently reviewed may be unique in the way it implements the dual receive function.[4] In all other radios that I've seen, while actually transmitting, both receivers are muted to off. In the Hilberling, the sub receiver is not muted during transmit unless in the split mode. What this means is that the Hilberling may be able to support SO2R (single operator, two radio) operation during a contest using a single transceiver. While this is not quite "dual transmit," it does allow for reception on a band in between you calling CQ, while you hunt and pounce on another band. Since SO2R contesting generally does not allow for simultaneous transmission on two bands, having one transmitter should not be a limitation — assuming your fingers can keep you doing the right thing on the right band.

Scott, NØIU, had a comment regarding my discussion about propagation prediction resources in the November 2014 column.[5] He brought to my attention that propagation charts of the type I remembered from c. 1970s QST *are still available, but now online at* ***www.arrl.org/propagation****. On that page, select "Current Propagation Charts."*

You can then select the region of the country where you live, which will bring up a portable document file (.PDF) with charts from that region to 12 regions around the globe. By looking at the frequency peaks and following that down to the time axis, this theoretically shows the best time range to work that region for the band desired. Of course, this is a prediction, not a promise!

Notes

[1]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

[2]*TLW, Transmission Line Program for Windows*, software is provided on a CD-ROM with *The ARRL Antenna Book*, 22nd Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6948. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[3]J. Hallas, W1ZR, "Getting to Know Your Radio — Dual Receivers — When One is Not Quite Enough," *QST*, Feb 2007, pp 61 – 62.

[4]J. Hallas, W1ZR, "Product Review — The Hilberling PT-8000?," *QST*, Nov 2014, pp 43 – 52.

[5]J. Hallas, W1ZR, "The Doctor is In — Folded Dipoles — Wideband or Not?," *QST*, Nov 2014, pp 65 – 67.

Do you have a question or a problem? Ask the Doctor! Send your questions (no telephone calls, please) to "The Doctor," ARRL, 225 Main St, Newington, CT 06111; for fastest response, e-mail **doctor@arrl.org**.

Steve Ford, WB8IMY, wb8imy@arrl.org

PSK63 Rising?

PSK63 is not a new digital mode. It was available in some of the earliest incarnations of the popular free *DigiPan* software that many amateurs still use for PSK31 (you'll find it at **www.digipan.net**).

For various reasons, however, PSK63 didn't seem to catch on, which is a little surprising. It is only about twice as wide as a properly modulated PSK31 signal, yet it is blazingly fast when it comes to text communication. Best of all, it accomplishes its impressive speed while still preserving much of the weak signal performance that makes PSK31 so attractive.

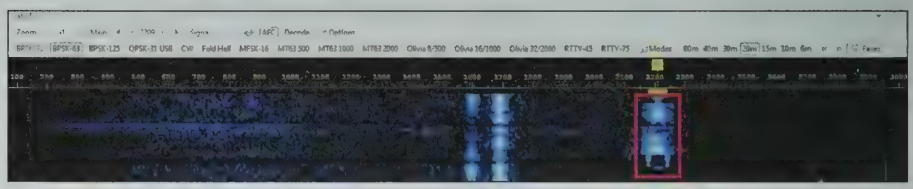
My pet theory about the slow adoption of PSK63 is that many amateurs find its speed intimidating. You have to be a fast typist to keep up with PSK63. I type for a living, but my fingers are often forced to fly on the keyboard when I'm engaging in a PSK63 conversation. My solution is to type comments into the transmit buffer window as I read the other guy's text. That way, I have a head start when I click TRANSMIT.

Of course, as many digital operators will tell you, macro "conversations" often dominate the PSK world. A typical contact can be little more than an exchange of canned macro texts with lists of station equipment and so on. With the speed issue in mind, it comes as no surprise that macros are prevalent with PSK63.

Over the last year or so, I've noticed an increasing number of PSK63 signals in the waterfall. On any given day — especially on weekends — I can switch on the radio and usually see one or two PSK63 traces among the PSK31 signals. They look like "fat" PSK31 tracks and they have a distinctive buzz/whine sound, quite unlike the gentle warble of PSK31.

PSK63 and APRS

While many hams are at least aware of APRS — the Automatic Packet Reporting System — they usually think of it as a VHF mode (specifically on 144.39 MHz here in the US). However, APRS has long had an HF presence at the high end of the 30 meter band. If you tune below the band edge, you'll hear occasional bursts of 300 baud APRS packet.

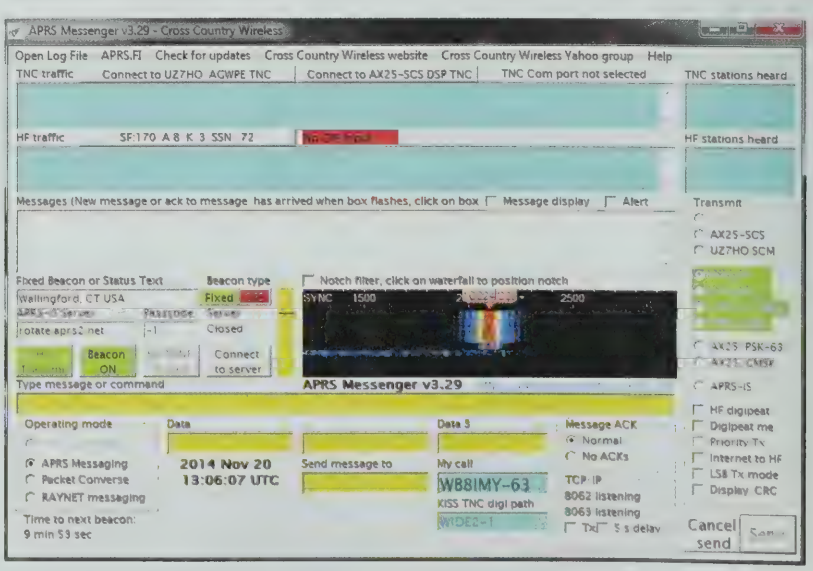


You'll find PSK63 signals popping up with increasing frequency (no pun intended). This is a PSK63 exchange taking place at 14.070 MHz. I've outlined the PSK63 signal in red.

These days, however, you may hear the buzz of PSK63 as well. This is thanks to a free *Windows* application known as *APRS Messenger*, created by Chris Moulding, G4HYG, of Cross Country Wireless fame. The program uses your sound device — the same one you use for PSK31 and other modes — to send and receive APRS data. *APRS Messenger* can also link to the popular *UIView* software so that you can see the location icons of the stations you are receiving.

Most of the *APRS Messenger* activity is currently taking place at 10.147.600 MHz USB. That's close to the edge, but the 2100 Hz PSK63 tone translates to RF at 10.149.700 MHz, which is still within the band.

The steps necessary to use *APRS Messenger* are well beyond the scope of a single-page column in *QST*. Instead, I highly recommend the web page of Stephen Smith, WA8LMF, at **www.wa8lmf.net/APRS_PSK63/**. Stephen has compiled everything you need to know about *APRS Messenger* in a well-written, easy-to-understand format. Just follow his instructions and you can try it yourself.



APRS Messenger by Chris Moulding, G4HYG.

H. Ward Silver, NØAX, n0ax@arrl.org

Experiment #146

Notes on Bonding and Shielding

One of the challenges facing the average ham trying to build a station is that the information needed is not collected in one place. Electrical safety (ac safety grounding) is discussed in one place, while lightning protection is discussed in another, and controlling RF is in yet other places. As we've seen, however, the needs for all three have much in common, including the physical wiring. The ham needs to read up on all three and approach station-building with a comprehensive strategy.

Bonding Conductors

One of the more popular materials hams use for "ground" connections is braided strap or shield braid removed from old coaxial cable, but that is *not* a good idea. Here is the problem — the wires in a coaxial cable shield are pressed together and protected from moisture and contaminants by the jacket. Once the jacket is removed, the wires slowly begin to corrode and the weave loosens. Pretty soon all those individual tiny wires start acting less like a large, flat surface and more like, well, individual tiny wires with poor connections between them. This is not very good for conducting RF.

For bonding at RF, use heavy wire or strap, such as copper or aluminum flashing. Solid wire, such as #14 or #12 AWG from home wiring cable, or stranded THHN wire works fine. The important thing is to maximize surface area because of the skin effect at RF.[1] For dc connections and for ac safety grounding, which are more concerned with resistance, braided strap is acceptable. Braid should also be used for bonding in high-vibration environments, but that's not necessary for most ham shacks, even mobile installations. For lightning protection and bonding earth connections together, use heavy wire or strap to minimize impedance and for mechanical strength.

Star Versus Bus Configurations

The answer to the question, "Should I use a star or a bus connection?" (see Figure 1) depends on what you are trying to accomplish. At dc and low frequencies, where resistance is the primary consideration, both are equivalent and the star connection is usually more convenient. At the higher frequencies involved for lightning protection, inductance becomes the most important characteristic. A star configuration with reasonably short connections will still provide adequate bonding.

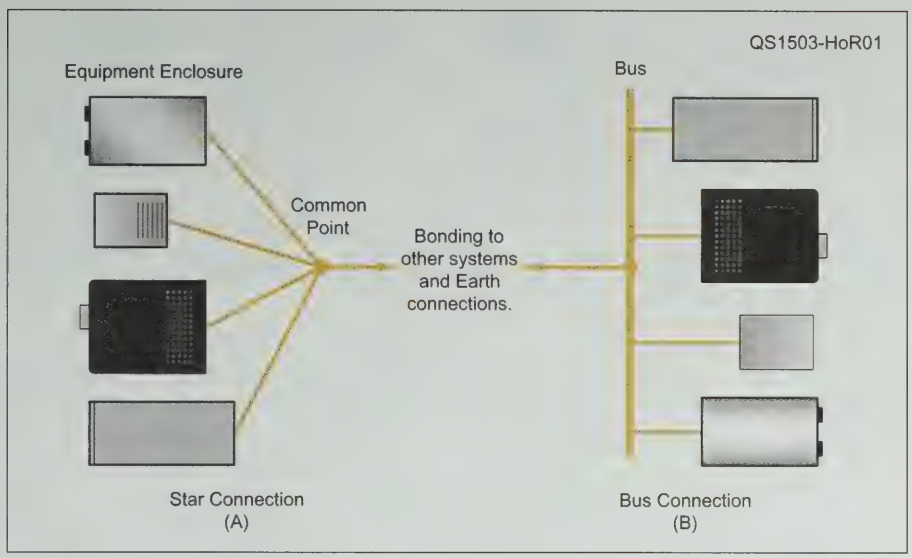


Figure 1 — The star connection at (A) and the bus connection at (B) accomplish the same safety functions for dc and ac power. As the frequency of interest increases, minimizing connection length and loop area makes a bus configuration preferable if compact.

At RF, however, the electrical length of the connection is the dominant consideration. The bus and star are trying to accomplish the same thing — keeping all of the equipment at the same voltage — but the bus does the job with shorter connections.[2] The length of the bus must be kept to a minimum. Connecting the enclosures directly together with individual wires is an alternative to using a separate bus conductor.

While trying to address ac safety, lightning, and RF control sounds complicated, minimizing the physical length of bonding connections addresses all of these concerns in the typical strong RF fields of a ham station. Bonding enclosure to enclosure using short conductors between interconnected equipment works for all three needs.

Minimizing Loop Area

The inductance of a one-turn circular loop is directly proportional to the natural log (ln) of the loop's radius: the bigger the loop, the greater the inductance. As inductance increases, so will the voltage between any two points in the loop whether the voltage is induced by a magnetic field or a rapidly changing current pulse.

What loop is this, you ask? The typical ham station is *full* of loops created by the shields of interconnecting cables, antenna system and control cables, ground connections, etc. Figure 2A shows the basic idea, and there are many more loops than the ones indicated in the drawing. Every complete conductive path around enclosures and cables counts as a loop.

Eliminating these loops is not realistic. Minimizing their area, on the other hand, is a productive strategy. First, use the minimum cable length. If you have two pieces of

[1]Notes appear on page 68.

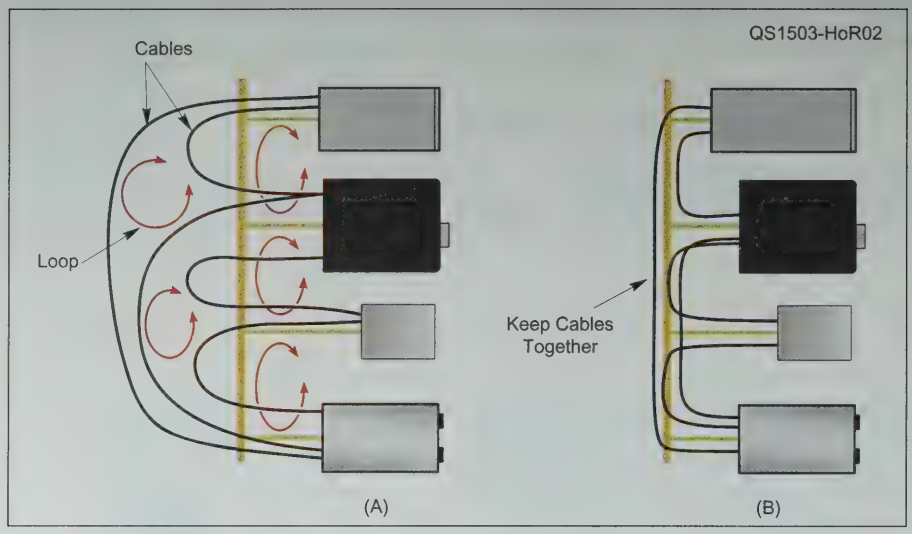


Figure 2 — Each conductive path through enclosures and cables creates a loop (A) that can pick up and radiate signals. Minimizing cable length and loop area by keeping cables together as at (B) can reduce pickup and radiation of RF.

equipment 6 inches apart connected with a 6-foot cable, replace that cable with a shorter one and coil up any extra length.

Next, minimize the area of each loop. Where several cables run in the same general area, use wire ties or a cable tray to hold them close together. Separate wires for power and ground should be twisted together, as should audio connections to speakers. If you use a bus for bonding equipment enclosures together, consider running your interconnecting cables along the bus as in Figure 2B, further reducing loop area.

Connecting Shields

Most hams understand the need to connect the shields of RF-carrying coaxial cables to metal enclosures, as in Figure 3A. One analogy is that of creating a "water-tight" connection as if the differential-mode RF signal was a fluid to be kept within enclosures and cable shield. This keeps any contaminating common-mode RF currents on the outside of the cable or enclosure. It also eliminates unwanted radiation of the RF signal from the internal electronics.

The same concerns apply to unbalanced data and audio connections. Figure 3B shows a two-wire connection with a shield, such as for one circuit of an unbalanced RS-232 interface. From the perspective of both susceptibility to interference and interference-causing, it is important that the external shield be connected to the enclosure and that any separate signal ground connections *not* connect to the enclosure. Keep internal signals and RF inside the cable and external RF out of the cable. Using twisted-pair cabling also helps prevent RF pickup and radiation.

Unfortunately, it is common practice in amateur equipment for multi-circuit connectors such as mono and stereo phone plugs to have their shield connections (usually referred to as the *sleeve*) isolated from the metal enclosure. Instead, the shields are often connected to an internal common point on a circuit board which is then connected back to the enclosure. Known in pro audio circles as the "Pin 1 Problem" because shields of audio cables are connected to Pin 1 of the standard XLR connector, this routes RF current on the outside of the cable shield to the internal electronics where it can do the most damage. At the same time, RF noise and harmonics from the electronics are routed to the outside world.

Worse, shields are sometimes left completely unconnected. This allows the RF current to enter the cable and flow into the electronics of whatever is connected. For a demonstration, turn on your HF transceiver and connect it to a dummy load. Even a short cable will do. Turn off any preamp or front-end filtering.[3] Note the level of background noise on, say, 20 meters. Now unscrew the shell of the PL-259 at the transceiver, leaving the center pin connected. The dramatic increase in noise is from signals being picked up by the cable shield and entering the cable to become differential-mode signals at the open end of the shield.

The ARRL's Safety page (**www.arrl.org/safety**) and RFI page (**www.arrl.org/radio-frequency-interference-rfi**) list many references and detailed articles to teach more about these topics.

Notes

[1] *The ARRL Handbook, 92nd edition*, (Newington: 2014), "Chapter 5: RF Techniques," p 5.1.

[2] See the Hands-On Radio web page (**www.arrl.org/hands-on-radio**) for Experiments #145 and #146.

[3] If the receiver has a high-impedance input, this demonstration may require a 6 to 10 dB 50 Ω attenuator at the inputs.

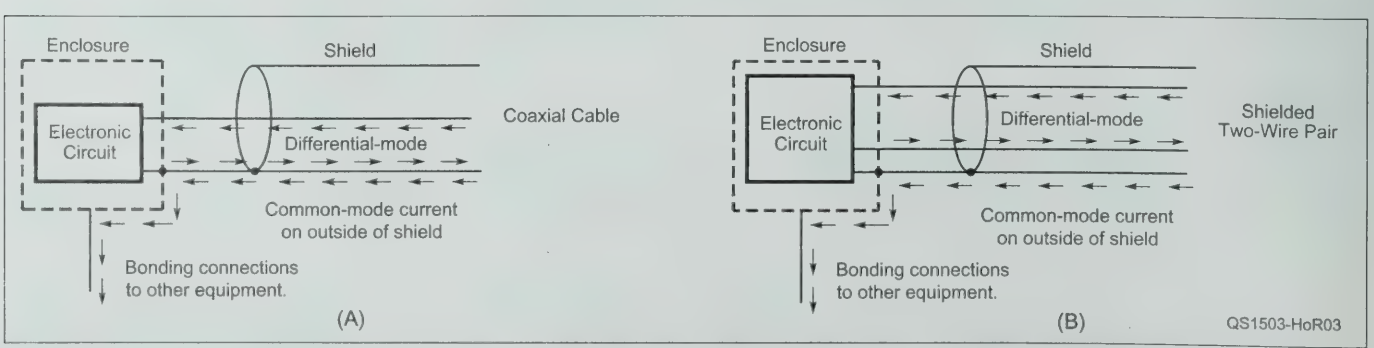


Figure 3 — It is important to keep common-mode RF currents flowing on the outside of cable shields from entering electronic equipment. Similarly, proper shield connections prevent RF signals generated by the equipment from being radiated by the cable.

Larry D. Wolfgang, WR1B, tc@arrl.org

More on Sag in Wire Antennas

A Computer Program to Calculate Wire Sag

When I read the March 2014 *QST* "Technical Correspondence" column, I thought you might like a program I wrote many years ago. Before retiring, I was a land surveyor. For about the last 20 years I worked for a large engineering firm as head of the surveying operations nationwide. We did transmission line engineering for large utility companies.

I wrote the "Sag Utilities" program so my survey crews could reduce the field measurements to design values, to compare with drawings or technical specs while in the field, so that errors would not force return trips. What we normally measured was the amount of sag, line temperature, span and support elevation data.

This simple program allowed us to take that data and determine the tension for a given temperature and ground or obstruction clearance for other factors. The program is available for download on the ARRL *QST* In Depth web page.[1] The program is also available for download at: **www.mediafire.com/download/0bc80x0i95bo7ps/SagUtil.exe**.

The *Sag_Utilities.zip* file on the *QST* In Depth web page includes a sample data file that you can load by using the FILE > OPEN pull down menu, and selecting the *testdata.sag* file.

You will probably only use the Catenary and Fit Sag options until you play with the program for a while. Figure 1 is a screenshot of the input data and calculations for the example given for the nomograph from the original January 1966 *QST* article, and the March 2014 "Technical Correspondence" column. Note that the CATENARY button has been pressed, and the appropriate data typed into the spaces for TENSION, WIRE WEIGHT/FT, CHANGE HEIGHT (the difference in height from one end of the wire to the other) and SPAN. Hit the CALCULATE button to find your results, displayed above the wire on the program screen.

A tip: the CATENARY CONSTANT field assumes the tension for a 1-pound-per-foot wire. Just multiply the catenary constant by the wire weight per foot to get the horizontally applied tension.

There are many other things we can do with this program. Assume you hang a dipole with 10 pounds of unsupported coax at midspan (using the same data for the other parameters). Divide the weight of the coax by the length of the span between supports; 10 lb / 420 ft = 0.0238 lb/ft. So, we will add 0.0238 lb/ft to the wire weight of 0.011 lb/ft, for a total weight of 0.0348 lb/ft, and plug that in as the weight/ft. The sag value goes to about 15.37 feet. The catenaries will not be correct but the sag point will be close. A screenshot of this example is included as *Fig_2.jpg* in the *Sag_Utilities.zip* file on the *QST* In Depth web page.

Suppose you want to limit sag to 7 feet. If you hit the FIT SAG button it will take you to a new screen, where you can fill in the 7 in the SAG box and hit CALCULATE. The catenary constant is now 3151.17. (This screenshot is included as *Fig_3.jpg* in the zip file.) To find the new tension required for the 7-foot sag, remember the tip from earlier — multiply the 3151 catenary constant times the 0.0348 lb/ft wire weight. This will give you a result of about 110 lb of tension required. One other note: in my program the variable TENSION is the horizontal tension, close enough for nearly level spans, but that would need to be adjusted for the

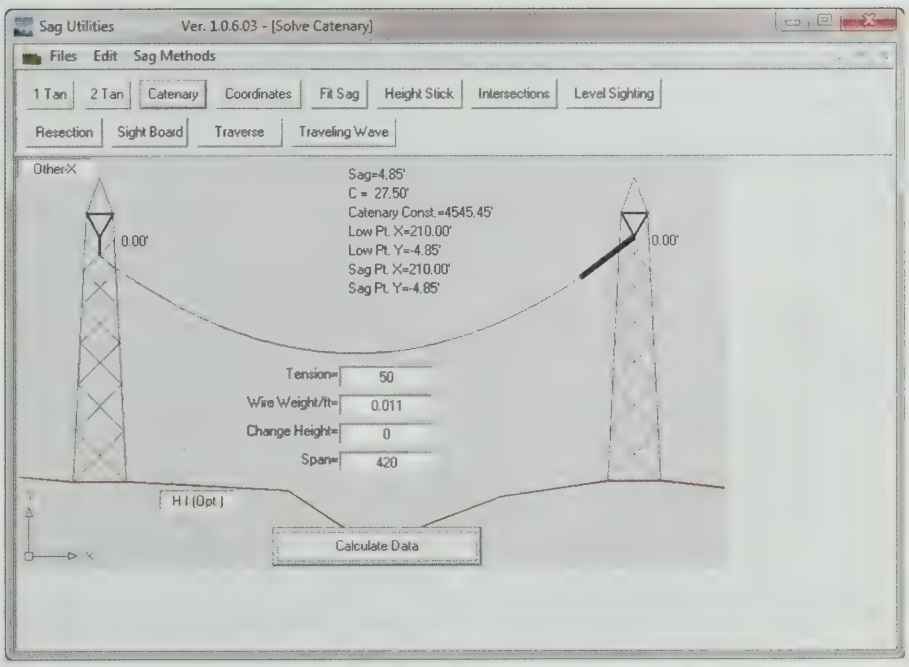


Figure 1 — This screenshot from Ron Watson's *Sag Utilities* computer program shows the calculation for the example used in the March 2014 *QST* "Technical Correspondence" column. The CATENARY button was pressed, the appropriate numbers entered in the spaces below the sagging wire, and then the CALCULATE DATA button was pressed. The results are displayed above the sagging wire. Screenshots from other examples discussed in the text are part of the *Sag Utilities.zip* file available for download from the *QST* In Depth web page. See Note 1.

[1]Notes appear on page 00.

cosine of the angle (horizontal span/cos angle from ground to guy point) for very inclined spans such as guy wires.

Instead of antennas, I find sag calculations to be more useful as guying or temporary guying indicators, such as calculating a pull tension for temporary guying that will not allow more than an inch or two of stretch on a back stay when increasing the side load by "tramming" antennas or equipment or bringing permanent guys to final tension. A tension gauge is also helpful for this, if one is available.

There is a useful calculator online that helps with the length. Go to **www.spaceagecontrol.com/calccabl.htm?F=50&a=420&q=.011&g=32.18503937&Submit+Button=Calculate**.

Using this calculator with the data from the original example, a change of tension from 50 to 400 pounds increases the wire length by about 2 inches, so you can see that temporary guying does not need real tight tensioning if you can allow the tower to move an inch or so with side load (wire only, no rope).

If you are using 3⁄16 inch EHS guy cable at a 70-foot high attachment point on a tower, and a guy anchor point 56 feet from the base of the tower (level ground assumed), then if you pull the temporary back stay with a 40-pound horizontal force, you will wind up with about 1 foot of sag in the guy cable, with approximately 66 pounds total tension (about 48 pounds of vertical tension) and a wire length of about 89.7 feet. Since the straight line distance of 89.7 feet = 70 feet high by 56.09 feet offset, it follows that a high tension on the opposite side of the tower will only move about 0.09 feet (about 1⅛ inches). Don't use this with rope! Even non-stretch rope has creep in it and may stress the tower. The angle of the guy from the ground is about 53° so the inline tension would be about 66 lb (40 lb/cos(53°)). (*Fig_4.jpg* is a screenshot of this calculation, included in the zip file.)

To get the approximate tension on a guy wire, say 400 lb in line with the guy with the same dimensions above, put 240 pounds of horizontal tension and pull up the slack until you have about 0.16 foot (1.92 inches) of sag.

I hope you find this information and my program to be useful. — *73, Ron Watson, AA4RW, 156 Charles Cir SE, Cleveland, TN. 37323*; **aa4rw@arrl.net**

Another Program for Calculating Antenna Wire Sag

I am writing about the "Technical Correspondence" letter in the March 2014 issue of *QST* about predicting sag in wire antennas. I am very interested in this subject, and I worked on it a few years ago to offer to the community a solution that is simple to use.

For this purpose I added a *Chain* function to my *Galva* program. This solution includes computations for non-horizontal (extremities not at the same height) wire antennas, and the possibility to reflect a load/mass somewhere along the antenna (to simulate a feed line).

I wrote an article about that in the February 2012 issue of Radio Amateurs of France IARU Society (L'association Réseau des Émetteurs Français) publication *Radio REF Revue*. You can download my article and my *Galva* software from my website at: **www.f5bu.fr/wp/?page_id=13**. *Galva* may be used in French, English, German, and Spanish, and the help is also available in Russian.

Galva is a command interpreter, including graphic commands. It was first built to draw scales for galvanometers, potentiometers, with linear, logarithmic, and others scales, including manual scales. These are easy to draw with the program. Over time, many other possibilities have been added.

The *Chain* function can be confusing, so I have included some examples, which I hope will make it much simpler to use. Even if the code is a bit more complicated, only a few parameters have to be entered/changed.

To give you an idea of what is possible, you can download a zip file with some sample data files from the *QST* In Depth web page. Look for the *F5BU_Galva.zip* file.[2]

GalvChain_A_en.pdf is a pdf print of the *GalvChain_A_en.dat* code example (=*GalvChain_A.dat* with translated commentary).

GalvChain_W1DQ.pdf illustrates the example used in the March 2014 "Technical Correspondence" column.

My conventions are that the wire antenna is suspended between point 1 and point 2. The coordinates of point 1 are *X1* = 0 and *Y1* = 0. *X2* is the abscissa of the second point (arrival). *DH2* is the vertical distance between the anchor points 1 and 2. *D* is the straight line distance between the two anchor points. *L* is the antenna length and *a* is the coefficient of the equation of the chain (catenary or wire antenna).

The departure angle is *aD*, also noted as *Theta_1*; *Theta_2* is the arrival angle. *T* is the tension on the antenna, *TV* the vertical component and *TH* the horizontal component, *k* is the linear weight of the wire antenna (weight per unit length), *FlècheV* is the vertical sag. The sag is defined as the maximum vertical distance between the antenna wire and the straight line connecting the fixing points. *X0* is a parameter in the real equation, which corresponds to the horizontal distance between point 1 and the lowest point (this is not of interest with horizontal antennas). *XF* is the horizontal distance between point 1 and the maximum sag point (this is the same as *X0* with horizontal antennas).

I distinguish the tension on the wire and its horizontal and vertical components. The *a* coefficient is equal to *TH* / *k*, and *TH* may be some value different from *T*, which is usually the practical known value (see *GalvChain_A*). So with the *GalvChain_W1DQ.dat* file example, using *a* = 4545.45 (= 50/0.011) gives *TH* = 50, *T1* = *T2* = 50.05 (horizontal antenna) and *FlècheV* = Sag = 4,852. Using *a* = 4541 gives *TH* = 49.95, *T1* = *T2* = 50 and Sag = 4.856. Other example files supplied with *Galva* allow us to select the antenna length or the departure angle.

GalvChain_LC.pdf is a pdf print of the *GalvChain_LC.dat* example file with a load (mass) at 35% of the wire length (this may also be expressed as absolute value: %LC1 = 35).

Many pdf files are available in the downloadable *Galva_200a-4L1.zip* file. These files may be seen without installing the program. Of course, to be able to write your own .dat files with *Galva*, you need to learn a little bit about the program, but using just the sag examples is very easy.

Installation is fairly standard: run the *setup.exe* file, start the *Galva.exe* file, choose your language, open a file and have a look at the help (F1), try some changes in an example file, and have some fun experimenting. — *73, Jean-Paul Gendner, F5BU, 182 route de Mittelhausbergen, Strasbourg, 67200 France*; **f5bu@orange.fr**

NVIS Myth Follow-Up

In the "Technical Correspondence" column

in the January 2015 issue of *QST*, we ran a letter from George Kidder, PhD, W3HBM, under the heading "The NVIS Myth — A Modeling Study." That letter brought several quick replies.

Several correspondents made some valid points about the NVIS operating strategy. Lloyd Bankson Roach, K3QNT, Western PA Section 2 District Emergency Coordinator, wrote to say, "While mostly accurate, he failed to mention that the NVIS method is a lot more than efficient or inefficient antennas. Near Vertical Incident Skywave methods were exhaustively researched by the German Wehrmacht, and Clarence Beverage, during World War II. In addition, LtCol David Fiedler, USMC did extensive work during the Vietnam War in 1968 on the efficacy of NVIS, especially in jungle and combat conditions. In the late 1990s we owed a great deal to the substantial practical testing performed over 8 years by Patricia Gibbons, WA6UBE (SK), on behalf of the California Department of Emergency Management.

"All of these authors made it abundantly clear that NVIS was a combination of antenna height, frequency, and power level. In order to create and maintain a successful NVIS circuit, all three must be maximized. Knowledge of propagation is every bit as important as antenna construction.

"The use of NVIS, especially during combat conditions demand a certain amount of stealth to avoid jamming, which often requires very low and inefficient antenna height. With this in mind, Dr Kidder's assertions about loss is irrelevant. I am personally acquainted with using NVIS methodology in US Navy amphibious beach operations and can tell you from personal experience, you do what works when you need it. This is why it is so effective during domestic emergencies. It can be easily and effectively deployed with minimal gear."

Paul Gibb, KB1TOR, also wrote with a few thoughts. "Thanks for your article in *QST*, which I found very interesting. Isn't NVIS and the use of low dipole antennas also about improving signal to noise ratio by eliminating/reducing received signals from distant sources? I am very interested in NVIS, because I have been involved with a project to equip a number of municipalities for NVIS operations when repeaters fail and terrain makes VHF simplex communications impossible. I am always looking for anything we can do to make short-range HF emergency communications practical and effective."

George Kidder, W3HBM, offered further comments as well. "Thanks for your interest. I did not mention the receiving situation, and you are right that receiving should be considered. On receive, it is the ratio between desired signal and QRM plus noise that is important, and an improvement of (say) 6 dB in high-angle signals as the result of raising a very low antenna would have the same effect as a decrease of 6 dB in the reception of QRM from afar. Only the S meter would know the difference. This assumes that both antennas have the same noise pickup from whatever source. I suspect that in many cases, local noise would be higher on a low antenna just because of the proximity of noise sources. This would be an interesting but very much longer study. With modern receivers, which can have instant selection of an independent receive antenna, or (with a sub-receiver) have diversity reception with two antennas, one could probably have the best of both worlds by transmitting on the high antenna and receiving on the low one. Of course, the choice of mode will also be important — dare I suggest CW as one answer?

"My 'Technical Correspondence' letter was intended as a quick look at one aspect of the NVIS operating strategy. Much has been written about choice of frequencies, operating modes and other considerations. I was not trying to duplicate (or dispel) that information. My letter focused solely on one aspect that I think is widely misunderstood — the belief that the closer to the ground that you put the antenna, the better it will be for transmitting signals over a local communications range, from ground zero out to a few hundred miles.

"I gave an example for a 75/80 meter dipole antenna. Perhaps I should have also mentioned the 40 meter band and even other bands for NVIS operation. I might also have given a more general 'rule of thumb' for antenna height, such as putting the dipole antenna between 0.1 and 0.25 wavelengths above ground."

Your editor also researched other articles about the NVIS operating strategy. There have been a number of *QST* and *QEX* articles published over the years.

Dean Straw, N6BV, wrote "What's the Deal About 'NVIS'?" in the December 2005 issue of *QST*. That article is an excellent tutorial, and it covers many aspects the operating strategy. Dean also cites a January 1995 *QST* article by Ed Farmer, AA6ZM, calling it "one of the best articles I've seen on NVIS operation." Recent editions of *The ARRL Antenna Book*, including the current 22nd edition, have an expanded version of Dean's article. This is excellent reading for those who want to understand more about the NVIS operating strategy.

Well-known antenna expert L. B. Cebik, W4RNL (SK), wrote about NVIS antennas in several of his "Antenna Options" columns for *QEX*. In the Jan/Feb 2007 issue of *QEX*, he expanded on Dean's *QST* article, and offered several alternatives to the basic dipole. In that column he also called attention to the ground model limitations of the *MININEC* program compared to the "high accuracy" ground of *EZNEC*, with a reference to another *QST* article — "*MININEC*: The Other Edge of the Sword" by Roy Lewallen, W7EL, in the February 1991 issue of *QST*.

In describing his reasons for writing this article for *QEX*, L. B. said, "The second purpose is to put to rest a certain persistent myth about NVIS dipoles, namely, that a super low height provides a gain advantage."

Please note that no one has suggested that a very low dipole will not work. No one has suggested that there is no such thing as NVIS propagation or operating strategy. The main point of Dr Kidder's letter was that if you are able to put your NVIS 80 meter dipole 50 or 60 feet in the air, do it. Of course if you are not able to put it higher than 10 or 15 feet it will still work, but your transmitted (and received) signals won't generally be as strong as they would be with the higher antenna. — *73, Larry Wolfgang, WR1B, Senior Assistant Technical Editor*; **lwolfgang@arrl.org**

Notes

[1]Ron Watson's *Sag Utilities* computer program is available for download from the ARRL *QST* In Depth web page. Go to **www.arrl.org/qst-in-depth** and look for the file *Sag_Utilities.zip*.

[2]The sample *Galva* program data files referenced in this letter are available for download from the ARRL *QST* In Depth web page. Go to **www.arrl.org/qst-in-depth** and look for the file *F5BU_Galva.zip*.

Steve Sant Andrea, AG1YK, hk@arrl.org

Converting Camouflage Spreaders, and an Antenna Wheel Well Mount

Converting Camouflage Spreaders

While at a local hamfest, I happened upon a set of fiberglass camouflage poles in a green duffel bag. The parts were originally designed to support various kinds of camouflage netting. The price was too good to pass up, so I bought them, thinking they would make an excellent portable antenna mast.

At home, I opened the bag and inspected the contents. Along with the poles came a strange object that looked like a four-armed paddle when it was opened up. It actually consisted of four separate arms, connected together at the center by a coupling nut. "I know what to do with the poles," I thought, "but what are the paddles for?" It turns out they are for making antenna wire spreaders and guy rings.

The round end of the paddles is the same size as the $6 guy rings sold for use with the fiberglass masts. All you need to do is cut the round part off the end of the paddle, mark the center, and drill out the holes to get a guy ring. I copied a previously purchased ring so it was easy to duplicate (see Figure 1).

Next, drill a ⅜-inch hole at the end of one of the leftover paddle arms. Then drill two ¼-inch holes through the arm at a point close to the large mounting hole (see Figure 2). Use this paddle arm as a pattern so you can make the holes in the remaining arms identical. Once you have drilled the holes, place the arms on the coupling nut and configure them in a T or cross. Drop a cotter pin or ¼-inch bolt through the ¼-inch holes to keep the arms from pivoting, and tighten the coupling nut.

You can string the wire though the spreaders and make an end-fed antenna or a center-fed dipole. Spreading the wire into an elongated loop in this way improves the antenna's bandwidth (see Figure 3).

The wire I have on this 75 meter antenna is about 190 feet long, but I am only occupying 96 feet of space. My tuner has no problem finding a match. — *73, Stephen Bellner, W8TER, 6853 Deer Ridge Rd, Apt 6, Maumee, OH 43537*, **w8ter@arrl.net**

Figure 1 — The disc end of the paddle can be cut off the arm, then drilled out to fit the mast and provide attachment points for guy ropes. [Stephen Bellner, W8TER, photo]

Mobile Antenna Lip Mount

Need to mount a mobile antenna? If the body panels around the rear wheel wells of your vehicle are metal and not plastic, you can use this type of mount for a very stable installation. The body panel is usually bent over at a right angle around the wheel well to form a lip. This lip is a good location to mount an antenna.

I used aircraft aluminum to fabricate the bracket, which is about 2 × 2½ inches in size and ¼-inch thick (see Figure 4). I drilled two holes 1 inch apart in the bracket, another two in the lip to match, and rounded off the exposed corners for safety. [After drilling the holes in the wheel well lip, you should paint or spray some rust-proofing primer on any exposed metal — *Ed.*]

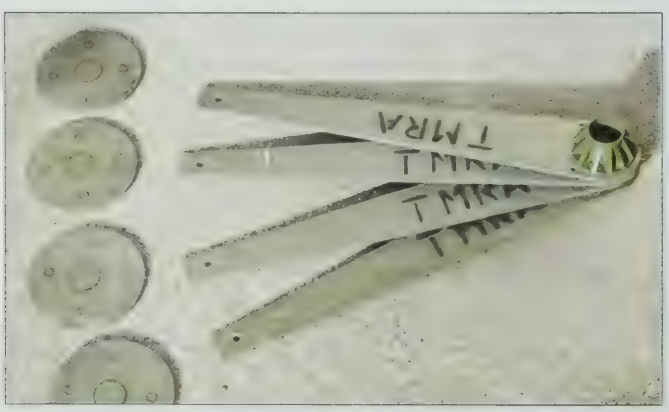


Figure 2 — After the disc is cut off of the arm, drill a large hole in the arm's disc end to support the antenna wire, and two smaller holes in the coupling nut end to lock the arm configuration. [Stephen Bellner, W8TER, photo]

Figure 3 — Three of the arms arranged in a T formation make great spreaders for dipole or loop antennas. [Stephen Bellner, W8TER, photo]

The only critical dimension is the large hole for the antenna base. It is ½ inch in diameter and must be checked for fit with the nylon washer provided with the mount. Note that the nylon stepped washer has a lip that fits into the hole to insulate the antenna from the car body's ground while an electrical ground is provided by the coax shield. The bayonet male part goes on top and the coax fitting on the underside (see Figure 5).

Most hamfests will be a source for the antenna base mount, the nut, and the bayonet for the mast. When purchasing the ¼-inch hardware, be sure to buy stainless steel parts.

The type of heavy mobile antenna this mount is designed for will also need an upper support. The upper support is fabricated from a ⅜-inch copper plumbing T cut lengthwise to fit against and partly around the antenna mast (see Figure 6). It is secured by a small turn-key type hose clamp, which eliminates the need for a screwdriver. The bottom of the T is drilled through and a screw secures it to a small fiberglass rod, which is then anchored to the crossbar of the roof rail (see Figure 7).

If one of the large resonators is used, a nylon cord from the mast just below the resonator to the front of the roof rail is a good idea (see Figure 8). In my installation, the elbow joint in the mast is properly positioned for the top part of the antenna to lie down on the roof when putting the car in the garage. When installing this mount on your vehicle, some planning regarding any fold-down features would be prudent. — *73, John H. Lehman, WA8MHO, 2553 Bell Rd, Lexington, OH 44904*, **wa8mho@arrl.net**

Figure 4 — This home-made bracket and a couple of stainless steel screws make a sturdy base support for a mobile antenna. [John H. Lehman, WA8MHO, photo]

Figure 5 — Attach the bracket to the wheel-well lip using two stainless steel screws. When mounting the antenna connector, don't forget to install the step washer to insulate the antenna from the car's ground. [John H. Lehman, WA8MHO, photo]

Figure 6 — A plumbing T cut lengthwise and secured to the antenna with a hose clamp provides an attachment point for a horizontal support. [John H. Lehman, WA8MHO, photo]

Figure 7 — The upper support is made from a cut-off plumbing T. A fiberglass shaft is attached to the other side of the T with a screw and tape to support the upper part of the antenna. [John H. Lehman, WA8MHO, photo]

Figure 8 — When using larger coils, it is helpful to add a guy line from the base of the coil to the roof rail or other attachment point. [John H. Lehman, WA8MHO, photo]

"Hints and Kinks" items have not been tested by *QST* or the ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Kinks" at ARRL Headquarters, 225 Main St, Newington, CT 06111, or via e-mail to **hk@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and e-mail address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

ARRL Board Holds 2015 Annual Meeting in Connecticut

Board fine-tunes DXCC rules and VHF and Above contest rules, lauds departing Director.

ARRL Board Okays Changes to DXCC, VHF and Above Contesting Rules

Gathering for its 2015 Annual Meeting January 16 – 17 in Windsor, Connecticut, the ARRL Board of Directors tweaked the DX Century Club (DXCC) rules to clarify and expand their recognition of remotely controlled station technology. It also added a rule putting greater ethical responsibility on operators, with respect to remotely controlled operation. In addition, the Board adopted changes to the ARRL VHF/UHF contest rules that are aimed at encouraging greater participation.

The changes affect Section I, subsections 8 and 9 of the DXCC Rules, which explain and extend how contacts with remotely controlled stations may now be applied toward DXCC. The subtle, but significant, changes make clear that contacts with legally licensed, land-based, remotely controlled stations do count for DXCC, but the control point — the operator's location — of a remotely controlled station no longer has to be land based; the operator can be literally anywhere.

"It has always been permitted for a QSO to count for both stations, if either station was operated remotely from a control point within the same DXCC entity," ARRL CEO David Sumner, K1ZZ, explained after the meeting. "Now the location of the operator doesn't matter; the operator could be on the far side of the Moon if he or she could figure out how to remotely control a station on land back on Earth from there." Transmitter location continues to define a station's location, and, for DXCC purposes, all transmitters and receivers must be located within a circle with a maximum 500 meter diameter, excluding antennas.

Under the old rules, if either station was operated from a control point in *another* DXCC entity, the contact did not count for DXCC for *either* station. "This was unenforceable unless someone was transparent about what they were doing," Sumner said.

New DXCC Rule Adopted

The Board further adopted a new rule, now Subsection 11 (subsequent rules have been renumbered accordingly), that acknowledges the reality of the technology enabling remote operation, and it puts greater

The ARRL Board met in January for its 2015 Annual Meeting in Windsor, Connecticut. [LJB Special Photography photo]

responsibility on the individual operator when it comes to applying that technology ethically and responsibly.

"Issues concerning remotely controlled operating and DXCC are best dealt with by each individual carefully considering the ethical limits that he/she will accept for his/her DXCC and other operating awards," the new rule states. It adds, in part, "the owner of these achievements needs to be comfortable standing behind his/her award and numbers. Peer attention has always been a part of awards chasing, of course, but in these times with so many awards and so many players, it is more important than ever to 'play the game ethically.'"

Subsection 11 acknowledges that technological advances "add to the difficulty in defining rules for DXCC," but stresses that the intent of the rules is what's important. "It will continue to be up to the operator to decide what types of legal remote control operating he/she will use (if any) to contribute to an operating award," the new rule concludes.

General VHF/UHF Contest Rule Revisions Okayed

The Board adopted amendments to the *General Rules for ARRL Contests Above 50 MHz* to encourage greater participation and band utilization in those events. The changes become effective with the 2015 June ARRL VHF Contest. The revisions stemmed from recommendations offered by the Board's Programs and Services Committee's ad-hoc VHF and Above Revitalization subcommittee. The panel is composed of active VHF/UHF contesters, and its proposals received strong support from the VHF/UHF community.

The subcommittee was charged with developing recommendations to increase the level and breadth of ARRL VHF/UHF contest participation and to encourage operation on lesser-used bands. As a start to the process, the Board approved three changes that will (1) permit assistance for all operator categories, with no effect on entry category, (2) permit self-spotting for all operator categories, and (3) allow single operators to transmit on more than one band at a time.

The changes will allow assistance in arranging contacts, but not in conducting contacts. They will, for example, allow a station to announce its location in a chat room, on a repeater, or even via e-mail.

Legislative Issues Advocacy Fund Receives Initial Donation

During the Annual Meeting, ARRL Hudson Division Director Mike Lisenco, N2YBB, on behalf of the members of his Division, presented ARRL President Kay Craigie, N3KN, with an inaugural donation of $4500 to the new ARRL Legislative Issues Advocacy Fund. The check, from the Long Island Mobile Amateur Radio Club, represented contributions collected at the 2014 Hudson Division Awards Luncheon on November 8. President Craigie generously matched the donation. The Board's Administration and Finance Committee established the Legislative Issues Advocacy Fund — proposed by Lisenco — to educate and inform members of Congress of the importance of issues that impact the Amateur Radio Service.

"There is an urgent need to raise money to help offset the cost of sending our voice to Washington for legislative advocacy, and we need to continue these expenditures into the future to achieve our goals — including and going beyond the current CC&R legislative effort — as there will always be issues that require a continuing presence on Capitol Hill," Lisenco said after the meeting.

Lisenco added that potential issues down the road could include spectrum allocation — and especially conflicts stemming from broadband allocations — revisions to the Communications Act, the adequacy and efficiency of FCC enforcement and the use of Amateur Radio volunteers, increased privatization of Amateur Radio administration, FCC oversight, and radio frequency interference concerns, "to name a few."

"We must establish a brand for Amateur Radio *now*, so that we no longer have to be reactive when it comes to the relationship between the federal government and Amateur Radio," Lisenco stressed after the meeting.

The ARRL is a tax-exempt 501(c)(3) entity. All donations to the fund are tax deductible within the limits of the law. For information on how to donate to the ARRL Legislative Issues Advocacy Fund, contact Development Manager Lauren Clarke, KB1YDD (860-594-0348).

ARRL President Kay Craigie, N3KN, receives a donation from Hudson Division Director Mike Lisenco, N2YBB, for the Legislative Issues Advocacy Fund. President Craigie matched the $4500 contribution. [Harold Kramer, WJ1B, photo]

Legislative Objectives Outlined

The Board adopted several legislative objectives for the 114th US Congress. Accordingly, the ARRL will continue to secure passage of legislation instructing the FCC to extend the requirement for "reasonable accommodation" of Amateur Radio station antennas — a requirement that now applies to state and local governing bodies — to all forms of land use regulation. The League will also continue to oppose legislation that may lead to the reallocation of amateur spectrum or to sharing arrangements that reduce the utility of existing allocations, as well as legislation that diminishes the rights of federal licensees in favor of unlicensed emitters or that encourages the deployment of spectrum-polluting technologies.

Among the other objectives, the ARRL will:

- Seek recognition of the unique resources, capabilities, and expertise of the Amateur Radio Service in any legislation addressing communications issues related to emergencies, disasters, or homeland security.
- Support complementary legislative objectives of other radiocommunication services, particularly the public safety and scientific services that require spectrum access and protection from interference for noncommercial purposes that benefit the public.
- Continue to oppose "distracted driving" legislation that does not clearly define the class of devices included in the regulation so as to exclude two-way mobile radio transmitters or receivers used by Amateur Radio licensees.
- Support legislation authorizing the FCC to appoint an electrical engineer or scientist as an additional staff member to ensure the Commissioners have adequate access to technical expertise when making decisions.

Ethics, Conflict of Interest Bylaws Revised

The Board amended its bylaws regarding ethics and conflicts of interest. The Ethics and Elections Committee now may make recommendations to the Board "in specific cases to address noncompliance" with ethical conduct guidelines. The Committee also may now "receive and evaluate" disclosures from Directors, Vice Directors, and candidates for those offices "of actual or potential conflicts of interest" and report its findings to the Board.

The Board also approved a revision of Bylaw 45, which spells out the Board's conflict of interest policy and constrains Board members or Vice Directors from disclosing to any third person or entity any confidential information they obtain relating to the League.

"Acknowledgement of conflicts through voluntary disclosure, and mitigation of the effects of conflicts, principally through some level of recusal, avoids the appearance of impropriety that otherwise might undermine confidence in the Board's policies," the bylaw states. Board members and Vice Directors would each year affirm in writing that they have received and read the current conflict of interest policy and agree to comply with its disclosure requirements.

Reports

ARRL Chief Technology Officer Brennan Price, N4QX, told the Board that efforts are in full swing to build support for Amateur Radio-related issues, in preparation for World Radiocommunication Conference 2015 in November.

ARRL General Counsel Chris Imlay, W3KD, pointed out in his report that spectrum auctions continue to pose a potential threat to Amateur Radio spectrum. He also told the Board that inadequate FCC atten-

Roanoke Division Director Bodson Retires

ARRL Roanoke Division Director Dennis Bodson, W4PWF, announced his retirement from the Board on the first day of the Annual Meeting. Vice Director Dr Jim Boehner, N2ZZ, succeeded him, taking the Director's seat for the remainder of the meeting. Bodson left the Board with nearly a year remaining on his term, which Boehner will complete. Fellow Board members gave Bodson a standing ovation in recognition of his more than two decades of service to the League. Licensed in 1955, Bodson served the League as Roanoke Division Vice Director from 1993 through 2000 and as Director from 2001 until his retirement. The Board subsequently elected Bodson as an Honorary Vice President.

Retiring Roanoke Division Director Dennis Bodson, W4PWF (right), and his successor, Director Roanoke Division Director Dr Jim Boehner, N2ZZ.

Bodson was the first chairman of the Electromagnetic Compatibility Committee, and also served as a member of the Ethics and Elections Committee, Executive Committee, Programs and Services Committee, and Administration and Finance Committee.

Earlier in the meeting, ARRL CEO David Sumner, K1ZZ, presented Bodson with his 60-year ARRL membership certificate and pin.

Boehner, an ARRL Life Member, served as ARRL South Carolina Section Manager from 2003 until 2009, when he was elected Roanoke Division Vice Director. He was re-elected in 2013. An avid DXer, he has achieved DXCC Honor Roll and 5-Band DXCC. Originally from New York, Boehner is in private medical practice in Aiken, South Carolina.

A few days after the Annual Meeting, ARRL President Kay Craigie, N3KN, appointed Bill Morine, N2COP, of Wilmington, North Carolina, to complete the remainder of Boehner's term as Roanoke Division Vice Director. An ARRL Life Member, Morine served as North Carolina Section Manager from 2010 until 2014, and is a past ARRL Public Relations Committee chairman. Morine was the 2001 recipient of the ARRL Philip J. McGan award for public relations.

Newcomers and Visitors

President Craigie presented certificates of office to new Midwest Division Director Rod Blocksome, KØDAS, and to new Atlantic Division Director Tom Abernethy, W3TOM. Both had served previously as Vice Directors for their respective divisions. Attending their first Board meeting and also receiving certificates of office were Midwest Division Vice Director Art Zygielbaum, KØAIZ, and Atlantic Division Vice Director Bob Famiglio, K3RF.

Also present for the Annual Meeting were International Amateur Radio Union (IARU) Secretary Rod Stafford, W6ROD, and Radio Amateurs of Canada (RAC) Vice President Glenn MacDonell, VE3XRA.

Tom Abernethy, W3TOM, attended his first Board meeting as the new Atlantic Division Director. [LJB Photography photo]

New Midwest Division Director Rod Blocksome, KØDAS, attended his first Board meeting as his Division's leader. [LJB Special Photography photo]

Stafford brought greetings from IARU President Tim Ellam, VE6SH, and Vice President Ole Garpestad, LA2RR and noted that 2015 is the 90th anniversary of the IARU. The IARU is preparing for the International Telecommunication Union World Radiocommunication Conference 2015, set for November in Geneva. MacDonnell conveyed greetings from RAC president Geoff Bawden, VE4BAW.

tion to Amateur Radio enforcement issues continues to be a concern.

Executive Committee, ARRL Foundation Board Members Elected

The Board elected New England Division Director Tom Frenaye, K1KI; Hudson Division Director Lisenco, N2YBB; West Gulf Division Director Dr David Woolweaver, K5RAV; Pacific Division Director Bob Vallio, W6RGG, and Great Lakes Division Director Dale Williams, WA8EFK, to the ARRL Executive Committee.

As members of the ARRL Foundation Board, the ARRL Board chose Northwestern Division Director Jim Pace, K7CEX, to fill the unexpired term of past ARRL Midwest Division Director Cliff Ahrens, KØCA, who stepped down from the Foundation Board. Elected for full 3-year terms on the Foundation Board were Director Frenaye, K1KI; Rocky Mountain Division Director Brian Mileshosky, N5ZGT, and Martin Green, K2PLF.

Frenaye, as ARRL Foundation President, reported that the Foundation funded some 80 scholarships in 2014, and that two new scholarships are in the process of being established.

Awards

The Board bestowed the 2014 George Hart Distinguished Service Award on David B. Colter, WA1ZCN, of New London, New Hampshire. Colter, a member of the Twin State Amateur Radio Club, was recognized for nearly four decades of service to the Amateur Radio community, including such leadership positions as Section Emergency Coordinator and Assistant Section Emergency Coordinator.

Colter designed training and development courses for the New Hampshire ARES community and was the prime mover behind the New Hampshire ARES Academy — a day-long springtime event that provides courses and training in various aspects of public service communication. He also served as editor of the ARRL Amateur Radio Emergency Communications Course (ARECC) series and as New England Division representative on the League's Emergency Communications Advisory Committee.

The Board also honored several professional journalists with the ARRL Bill Leonard Award for their outstanding coverage of Amateur Radio in video, print, and audio media.

The video award went to Christine Kim of KSNV-TV in Las Vegas, for her "Local Heroes" profile of the Nevada Amateur Radio Emergency Service.

The print award went to Marti Attoun of *American Profile* magazine, for her "Radio Active" article that profiled Amateur Radio.

The aural media award went to Steve Kraske and Beth Lipoff of KCUR-FM in Kansas City, for their "Exploring Ham Radio in a Digital World" interview of Brian Short, KCØBS; Carolyn Wells, NØCJ, and Matt May, KC4WCG.

Additional Board Actions

- Instructed the HF Band Planning Committee — which soon will solicit members' comments on proposed changes to the ARRL HF Band Plans — to include the possibility of requesting that the FCC add RTTY and data privileges for Novices and Technicians on 15 meters.
- Agreed to form a Strategic Planning Working Group that would create a high-level strategic plan during 2015 for presentation to the Board for approval at its January 2016 meeting.
- Created a new field appointment of "Assistant Section Traffic Manager," to serve as a direct assistant to the Section Traffic Manager and with authority to act on the STM's behalf in his or her absence.
- Authorized ARRL Headquarters staff to implement guidelines to expand opportunities for field checking of 160 meter QSL cards for DXCC.
- Expressed "its deepest gratitude" to the members of the ARRL Second Century Campaign Committee, which succeeded in raising more than $7.5 million in contributions and pledges "including generous support by the Committee members themselves."

Single Operator Portable in the Dry Tortugas

A 3-day holiday-style operation in rare grid EL84, Garden Key, Florida.

Dan Passaro, AK4PX

In Spring 2014, I got the idea of operating "guerrilla portable" on a deserted island. I wanted to bring a battery and solar array, set up a stealth antenna, sleep under the stars, and catch fish with my bare hands. Dry Tortugas, a national park 67 miles west of Key West, Florida, with a live-in staff of rangers and daily ferry service, seemed like a natural destination, given that I lived in Miami, Florida — only 3½ hours from Key West.

However, just one mention of the trip on an online forum generated a response that ruined my dream of just sitting on the beach with a cold drink in one hand and a microphone in the other. Upon hearing that I was planning to go to Dry Tortugas, Hank Ellis, K5HDE, wrote: "You'll be in grid EL84, which is one of the most wanted grids for those chasing the Fred Fish Memorial Award [FFMA] and VUCC. People will be champing at the bit to add that grid to their list."

I'm a rather new ham, having gotten my call in January 2012, so when people started responding to the post, talking about FFMA, IOTA [the Islands On the Air (IOTA) program, administered by the Radio Society of Great Britain (RSGB), is where hams can earn awards by operating from, or contacting, certain approved islands around the world. Learn more at **www.rsgbiota.org**. — *Ed.*], and other such things that I had no knowledge of, I realized that I needed to study up — and that I'd need to postpone and rethink my guerrilla portable trip.

Grid Chasers, Island Chasers

My study began with the Fred Fish Memorial Award, or FFMA. Fred Fish, W5FF (SK), was the first amateur to work and confirm 6 meter contacts to all 488 Maidenhead grid squares (see the sidebar, "The Maidenhead Locator System") in the 48 contiguous United States. The FFMA is given to hams who accomplish the same thing. I couldn't see myself chasing grids, but the idea of providing a rare grid to other hams was enticing. Clearly, it would be a waste to go all the way to Dry Tortugas with a random band plan and an average antenna, so I began research for an off-grid station for 6 meters and other ham bands.

Choosing Compact Gear

That's right, off-grid. There's nothing at Garden Key. You even have to bring your own water. Packing it all in would be a challenge. Because of that, I knew my antenna would have to be lightweight and break down to less than 48 inches — a number I decided on as simply being easy to handle, given that I had to bring a number of other items with me, including water. I determined that a beam for 6 meters would maximize the chances of success. I would also need a mast and tripod to support that beam. But which beam?

My research boiled down to two setups that fit within National Park requirements and that seemed to be potential winners for the grid expedition. I chose a Yagi for 6 meters, a ¼-wave vertical for 20 meters, and an 18-foot mast that collapsed to just 40 inches.

Above: A view of AK4PX's station on the North Coaling Dock. Ten watts over a salt water ground plane was good for reports up to 20 over.

The other consideration was power. A 100 W rig would suck the life out of a battery in no time. Even setting that type of rig to 20 W output would be a big drain. But a rig purposely designed for low-power operating would be just right, allowing me to carry just enough battery, as well as the water, the tent, the food, and everything else — and still survive the experience. I decided to bring Icom's IC-703 Plus and a 27 W folding solar panel. By design, the 6 meter antenna setup had an SWR of 1.2:1. With the 703's internal tuner, I would be able to leave the vertical set for 20 meters and still make contacts on 17, 15, 10, and even 6 meters.

Permits and Planning

Once I had my gear settled, it was time to get a permit to operate. I would be on Dry Tortugas in mid-June for the ARRL June VHF/UHF contest. I submitted a hand-drawn diagram of my operation, the necessary forms, and the fee, and after a little bit of back-and-forth, I received my permit. I made five copies, just in case I needed to give any out during my operation, and put them in my trip binder. Prior to the trip, I went down to the ferry in Key West to see what I'd be dealing with concerning space for all the gear. It was a good idea, because the ferry's area for storing camping gear turned out to be smaller than I anticipated. I had been planning to put my gear in a frame pack, but after seeing the storage space I switched to a large duffel that

The Maidenhead Locator System

The Maidenhead Locator System, familiarly known as the "Maidenhead grid system," was introduced 30 years ago. Here is some background information about why the system was needed, where it came from, and how it works.

Jaap Verheul, PA3DTR

In the 1950s, there was a need among central European hams for an easy way of giving positions in VHF and UHF contests. This was because contest scoring was based on the distance between the two stations — for example, 1 point per kilometer. Therefore, the QRA Locator was introduced.[1] This locator system used two letters to indicate the largest unit, the "square," which was 2° longitude by 1° latitude. All squares were divided into 100 "sub squares," and all sub squares were divided as well. Without repetitions, the system covered the area 0 – 52° Eastern longitude and 40 – 66° Northern latitude. That was also its shortcoming — it did not cover the whole face of the Earth. However, at that time QSOs on VHF and UHF between continents were exceptions.

A portion of the ARRL Amateur Radio Map of North America, showing Maidenhead grid square locators.

The Quest for Something Better

In 1978, International Amateur Radio Union (IARU) Region 1 contacted the other regions on this topic and called for papers proposing a new system. In April 1980, a meeting of European VHF managers was held in Maidenhead near London, UK, to evaluate the more than 20 proposals received. The prevailing system was one proposed by John Morris, G4ANB, with the modification that the starting point should be shifted to the principal dateline. The "Maidenhead Locator System" was adopted by the IARU starting on January 1, 1985 (Region 1).[2]

How It Works

The Earth's surface is divided into 18 × 18 = 324 "fields" that are 20° longitude × 10° latitude. Each field is divided into 10 × 10 = 100 "squares" that are 2° longitude × 1° latitude. Each square is finally divided into 24 × 24 = 576 "sub squares" that are 5 minutes longitude × 2.5 minutes latitude. The fields are indicated by two letters AA – RR, the squares by two digits 00 – 99, and the sub squares by two letters AA – XX. The first character is the longitude and the second character is the latitude on each level. The numbering is always West to East and South to North. Keep in mind that in fact not an exact spot but an area is designated. However, for most applications, this is good enough.

Distance, Bearing, Quick Reference

One of the features of the Maidenhead locator is that, when translating two given locators back to longitude and latitude coordinates, calculation of distance is possible. In the early 1980s, this was done by the use of calculators, later on with simple basic computer programs.[3] Today most logging software programs accommodate the automatic calculation of distance. **QRZ.com** also lists distance when you are logged in and looking up calls in the call book. Another feature is that the easy to exchange locator can be looked up quickly on a map in the shack. In digital modes such as RTTY, PSK31, and JT65, exchanging locators is common practice and, for the latter, even part of the standard calling CQ.

Internet

The proliferation of the Internet brought new possibilities. Packet DX clusters are transformed to Internet pages and it becomes possible to automatically post spots you hear on the internet. When together with time, frequency, call, and the locator is also listed, an interesting insight into propagation and activity is born; a reverse beacon network.[4] This is an excellent way to monitor propagation.

Conclusion

The Maidenhead Locator System is now common practice for hams worldwide. It is not the only system around, however, it is unique if you take into account why it was developed, how it works, and how much it adds to the joy of Amateur Radio.

Notes

[1]W. A. Tynan, W3XO, "Progress Toward A World Wide Locator System," *QST*, Sep 1980, p 62.
[2]W. A. Tynan, W3XO, "Controversy Over Selection of a Worldwide Locator System," *QST*, Feb 1981, p 70.
[3]W. Overbeck, N6NB, "A Universal Grid-Locator Program for Your Personal Computer," *QST*, Dec 1986, pp 30 – 32.
[4]**www.reversebeacon.net/main.php**

ARRL Member Jaap Verheul, PA3DTR, has held an Amateur Extra class license in The Netherlands since 1985. Jaap works as a senior consultant for the Dutch-based company Royal HaskoningDHV in the business line Energy, Industry, and Mining. His main interests in ham radio are contesting, digital modes, antenna experimenting, and pursuit of DXCC on 30 meters. You can contact him at **pa3dtr@hetnet.nl**.

would fit the space. I also brought several heavy-duty lawn bags to place over the duffel and the dolly that I was using to transport larger items. This would minimize salt spray intrusion, so I wouldn't have to use my supply of fresh water to clean the salt off my gear.

Day 1, June 14

After getting off the ferry on Garden Key, I set up my base camp, then did a recon of my operating area. I had decided to operate from the North Coaling Docks, which offered an uninterrupted path to the entirety of the Gulf of Mexico for transmitting into the mainland United States — over salt water, which would provide a boost to my transmission. Once the contest started, I was often given reports of 5-9 to 20 over, on just 10 W into the vertical. It was a perfect operating position.

I decided to run with the external battery first, keeping the solar panel plugged into it for as long as the Sun was up. I followed the practice of listening for three complete (or mostly complete) calls, writing them down, then calling for those three. That evening, strong winds motivated me to take everything down. A condition of my permit was that I was not to leave anything unattended overnight. I hauled everything back to base camp and collapsed onto the air mattress for the night.

Day 2, June 15

It had been too hot to sleep comfortably. I was awake at 6:30 AM and managed to nap until 9. At 11 I was glad to get on the ferry and have lunch in the air-conditioned cabin. Semi-refreshed, I hauled my gear back to the North Coaling Docks and operated.

Day 3, June 16

I went snorkeling in the morning, and then set off for my station. I guyed the Yagi against the wind and got on 6 meters. At one point, I took a break and went back to my base camp, and while I was there, the wind picked up and I felt some light drops of rain. I jogged back to my station, but it was already too late — the Yagi was down for the count. Three of the four whips were broken, and I had only one spare. I could use the extra-long whip (for the vertical) as well, but that would still leave me one whip short.

Throughout the grid expedition, there had been one specific contact I'd been trying to make. I'd had five "appointments" with Todor, LZ1HA, so far, and we had failed to complete the contact each time. The sixth and final "sked" was fast approaching, and I had to think of something. After rinsing the sand off everything, I reassembled the antenna into the 20 meter vertical, and with the help of Roger, W9YU, set up an "e-mail patch," which entailed Roger e-mailing Todor to tell him that I was on frequency and ready for the contact. Thanks to that e-mail patch, I was able to make the contact to Bulgaria. Todor was so happy to finally get IOTA NA-079, Dry Tortugas, into his log, I could hear it in his voice. That contact made my whole weekend. Even the busted Yagi didn't bother me one bit after that.

Day 4, June 17

There was no hamming on my final day. All my gear had to be on the dock by 10 AM so the campgrounds would be ready for new arrivals. Once the ferry was loaded up, I was on my way back to Key West and, eventually, home.

It had been an enjoyable trip. When I wasn't checking out historic Fort Jefferson or just admiring the sunset, I was on the North Coaling Dock under the tarp I'd set up as a sunshade for myself and the rig, leaning back in my sand chair facing into a majestic, unobstructed view of the blue-green waters of the Gulf of Mexico. The trip turned out to be not so different from my original plan of relaxation and guerrilla operating — I just did a little more planning than I'd originally planned on!

AK4PX's portable "Shack in a Can," showing the voltage of the internal battery (top readout) and the voltage of the plugged-in external battery (lower readout).

AK4PX posing at the North Coaling Dock operating position with the 20 meter ¼-wave vertical. His station is at left, protected from the Sun by a Mylar canopy.

All photos by the author.

Dan Passaro, AK4PX, graduated from Carnegie Mellon University with a Bachelor of Science in Mechanical Engineering, before moving on to Detroit, Michigan to work in the automotive industry. On January 23, 2012, after concentrated study, he took all three Amateur Radio license exams, going from zero to Amateur Extra in one morning. He currently enjoys writing science fiction, working toward his Private Pilot Certificate, SCUBA diving, and operating HF and VHF mobile. He can be reached at **ak4px@arrl.net**.

VOTE
Did you enjoy this article? Cast your vote at www.arrl.org/cover-plaque-poll

Teaching the Future with Ham Radio

Virginia's Chesapeake Public School System introduces Amateur Radio into its electronics classrooms.

Edith Lennon, N2ZRW

John Bowser, W4RMY, a Career and Technical Education (CTE) teacher at Great Bridge High School (GBHS), in Chesapeake, Virginia, is a man with a plan: to make Amateur Radio an official part of his school system's STEM (Science, Technology, Engineering, and Math) coursework. By developing a curriculum for his high school's electronics classes that incorporates Amateur Radio concepts and hands-on experience, he wants to empower the next generation of technical professionals and innovators. "My teaching philosophy from the beginning was to provide students with a more hands-on and pragmatic learning experience that would give them skills that could be used throughout their lifetime," says Bowser.

Lucas Dunham with the FM radio he built for Electronics I, the precursor to Electronics II. [John Bowser, W4RMY, photo]

Having already put his philosophy and practical approach to work by using Amateur Radio in his own classroom, Bowser is taking the next step. His class is now a pilot program to determine if the curriculum will be implemented in all of his district's high schools.

Amateur Radio, an Ideal Teaching Tool

Coming from a career that spanned naval aviation, design engineering, and aircraft mechanics instruction, Bowser began teaching basic and advanced electronics as well as wood shop at GBHS in 2012, around the same time he became interested in Amateur Radio.

"In the fall of 2013, I began looking for a good way to teach the advanced electronics class, Electronics II, the following spring," says Bowser. He'd been studying for the General class exam and "noticed quite a lot of similarities between what I was learning for the General test and the state competencies listed for the electronics class." He realized that using radio to teach electronics offered several advantages. "Students use wireless technology every day without thinking about it," says Bowser, adding that, "wireless technology, and Amateur Radio in particular, provides a hands-on way to illustrate many of the concepts involved." Critically, it also offers many opportunities for future careers.

The Electronics II class typically has about 20 students, ranging from grades 9 – 12. To gain acceptance for his proposal to incorporate a "wireless technology approach," Bowser first had to demonstrate to the CTE office and the district's curriculum development office that it was a relevant and practical way to teach the subject. Once approval was granted, he developed a pacing guide — a kind of instructional road map — which laid out all the required state competencies through the length of the course. He paired these competencies with material and subject matter involving wireless technology, using Amateur Radio to demonstrate the concepts.

Support from the Ham Community

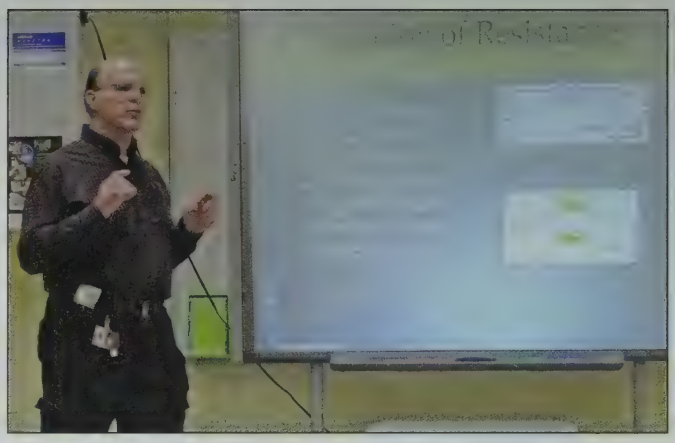
The process of integrating radio into the class accelerated when Bowser discovered K4AMG, a local non-profit Amateur Radio group dedicated to teaching electronics and wireless communication through the mentoring of youngsters. K4AMG was instrumental in getting GBHS' Amateur Radio station operational by purchasing or lending all the equipment needed to get on the air, as well as providing technical support.

Today, for HF operation, the school boasts a Kenwood TS-850 transceiver with an LDG AT-200Pro autotuner, a SignaLink USB sound card interface, and an 80 meter Carolina Windom antenna. VHF operation is via a Yaesu FT-1900R transceiver connected to a J-pole antenna. It's all used by the students, who, along the way, learn related concepts and skills, such as propagation analysis and soldering. Further, by operating from the school's radio club, W4GBH, they learn to understand and comply with governmental regulations.

To offer students a promising career path, Bowser emphasizes digital modes in his hands-on lessons. "I believe that the digital modes are a big part of Amateur Radio's future as well as being an excellent teaching tool for the students and their future in radio communication," he says. Currently, GBHS is operational on PSK31, JT65-HF, packet, and RTTY.

For lesson material and planning, Bowser

received assistance from the ARRL® through its Education & Technology Program (ETP) and Teachers Institute on Wireless Technology (TI) professional development seminar, which he attended in 2014. Both are part of the League's educational outreach to introduce teachers to Amateur Radio as an instructional resource and to provide an educationally sound curriculum focused on wireless communications. Information about the 2015 TI schedule can be found elsewhere in this issue.



John Bowser, W4RMY, teaching a lesson on complex circuits to his Electronics II class. [Josh Brown, KF4HJO, photo]

"One of the challenges was choosing specific activities from the large amount of material I had to pick from," says Bowser. "The ARRL TI provided a wealth of information and activities, all of which could be used as course material." Bowser has also been using content from the ARRL licensing manuals to teach concepts such as Ohm's Law, series and parallel circuits, and component identification.

Building on Success

After being tasked by Chesapeake Public Schools' CTE supervisor with developing a curriculum for possible broader implementation, Bowser worked with two electronics teachers from other district high schools to update his original pacing guide and incorporate additional resources for teaching the Electronics II coursework. The goal in revising the curriculum was to incorporate all of the Virginia Education Resource System Online state competency requirements within the material covered, as well as to increase the pass rate for the industry standard test administered by the National Occupational Competency Testing Institute, which may be taken at the end of the Electronics II class for industry certification.

The spring 2014 semester was the first to see full implementation of Amateur Radio in the Electronics II class and student interest level was greater than even Bowser anticipated. He says students find it fascinating and three have already obtained their licenses. He also learned that two fellow teachers at the school have Amateur Radio licenses and that this has motivated them to upgrade. (Bowser himself now holds an Amateur Extra class license and is a Volunteer Examiner.)

GBHS' Electronics II class has now become a pilot program for the district to evaluate how well Amateur Radio performs in the classroom setting. Its implementation at the other high schools will be at the discretion of the school administration. If fully adopted, at least 100 students across seven high schools will likely be exposed to the new Amateur Radio-infused curriculum.

"How this grew beyond my classroom I really can't say for sure," says Bowser, "but what I do know is that the school district really wants students to get involved and be interested in learning, and they saw in Amateur Radio a means to accomplish this."

Edith Lennon, N2ZRW, an ARRL member, has been licensed since 1994 and is especially intrigued by Amateur Radio's ability to reach around the globe unimpeded by political borders. She is a freelance journalist and a contributing editor to the ARRL Education Services Department's *Radio Waves* newsletter. Edith can be reached at **edithmlennon@gmail.com**.

VOTE
Did you enjoy this article?
Cast your vote at
www.arrl.org/cover-plaque-poll

Strays

QST Congratulates...

New National Oceanic and Atmospheric Administration (NOAA) "Weather-Ready Nation Ambassadors" (from left to right) John H. Nielands, W3YDC; Jeffrey Littman, N2AES; Jim Biddle, W3DCL; Mike Thomas, KB3SUS, and Joe Hennelly, KB3BMI, shown here at the December meeting of the Marple Newtown Amateur Radio Club in Delaware Country, Pennsylvania. The Weather-Ready Nation Ambassador initiative is NOAA's effort to formally recognize partners who are improving the nation's readiness, responsiveness, and overall resilience against extreme weather, water, and climate events.

The ARRL Teachers Institute on Wireless Technology

Equipping teachers for the STEM challenge.

Debra Johnson, K1DMJ
ARRL Education Services Manager

As our nation looks toward an increasingly high-tech future, our educational system must improve the preparation of our students in the areas of Science, Technology, Engineering, and Mathematics (STEM). Teachers and schools are looking to meet these expectations by providing students with opportunities for hands-on, project-based learning. The ARRL's Teachers Institute (TI) offers teachers a professional development opportunity that equips them with training and resources for exploring a variety of applications of radio science and wireless technology.

In 2015, the ARRL Education & Technology Program (ETP) will offer three introductory TI sessions and one advanced seminar during June and July. *Introduction to Wireless Technology* (TI-1) sessions will be hosted by Parallax, our robotics partner, in Rocklin, California; by the Dayton Amateur Radio Association in Dayton, Ohio, a generous supporter from the Amateur Radio community; and the ARRL at its Newington, Connecticut headquarters. These expenses-paid professional development seminars present tools and strategies, including Amateur Radio, to introduce students to many STEM related concepts.

During the 4 days of the TI-1, teachers will have the opportunity to gain a solid understanding of basic electronics and radio science. TI-1 also includes a hands-on introduction to microcontrollers and basic robotics, and, new this year, an introduction to RFID technology.

Previous graduates of TI-1 can expand their STEM skills by attending the 5-day *Remote Sensing and Data Gathering* (TI-2) seminar, which will be offered at ARRL Headquarters in late July.

The TI-2 seminar features a marine research buoy outfitted with sensors. The buoy is a hands-on project that each teacher assembles and programs. This "do it yourself" activity trains the teacher in how electronic sensor data is converted into usable information about the environment, how the microcontroller is programmed to sample the data, how to configure APRS to send and receive the data, and how to upload the data into *Excel* for evaluation and analysis. In the classroom, students can learn about remote telemetry by programming the buoy themselves and deploying it in a local body of water to do environmental research. The expanded TI-2 curriculum for 2015 will also include an introduction to the MAREA (**www.arrl.org/marea**) activity, and additional training in gathering satellite telemetry data with classroom applications to math and science topics.

Teachers at the Dayton TI-1 assemble the Boe-Bot® robot, which they will use to learn microcontroller programming and robotics.

The Teachers Institute is open to teachers of grade levels 4 – 12, as well as post-secondary educators. We look for teachers who have a vision of how to apply this wireless technology training to support STEM learning in their classrooms. Interested teachers will find more details and applications at **www.arrl.org/ti**. Applications are due by May 1, 2015.

Fund a Seat at the Teachers Institute!

Consider the impact one enthusiastic teacher can make on a classroom or several sections of students during a school year. You can help that teacher make a difference by funding his or her seat at the Teachers Institute. With your help, ARRL can continue this important work of training teachers and inspiring young people with Amateur Radio in their classrooms.

Direct costs to provide for travel, accommodations, instruction, and resources for one teacher at the TI are $2000 – $2500. The Teachers Institute is supported by donations to the Education & Technology Fund. ARRL President Kay Craigie, N3KN, herself an enthusiastic donor to the Education & Technology Program, explains her personal passion for this program in her letter to ARRL members at **www.arrl.org/education-and-technology-fund**.

Donations from the ham radio community have helped the ARRL Education & Technology Program provide teacher training to more than 650 teachers since the inception of the Teachers Institute in 2004.

Let's keep a good thing going, one teacher at a time!

2015 Teachers Institute Schedule

Dates	Location
TI-1 Introduction to Wireless Technology	
June 22 – 25	Parallax, Rocklin, CA
July 7 – 10	ARRL Headquarters, Newington, CT
July 13 – 16	Dayton Amateur Radio Association, Dayton, OH
TI-2 Remote Sensing and Data Gathering	
July 20 – 24	ARRL Headquarters, Newington, CT

Rick Lindquist, WW1ME, ww1me@arrl.org

Centennial Spirit Will Live On, ARRL President Predicts

League's Centennial "most extraordinary event" for ARRL President

ARRL President Kay Craigie, N3KN, believes the League's year-long Centennial celebration helped to rejuvenate Amateur Radio by including as many people as possible, providing lots of on-the-air fun, and promoting learning and doing. She predicted that the spirit of the Centennial will live on in Amateur Radio's second century.

ARRL President Kay Craigie, N3KN.

"The ARRL Centennial has been the most extraordinary event in my Amateur Radio life," President Craigie remarked as 2014 drew to a close. "How fortunate I am to have been a ham in this anniversary year, let alone to have been President of the ARRL."

President Craigie said that Centennial activities, such as the Centennial QSO Party and the W1AW portable operations in all 50 US states and some territories, were aimed at giving members a chance to learn, to feel, and to do, and in the process generated positive feelings about being a part of Amateur Radio and the ARRL. "We wanted members to have fun participating in activities, both in person — at the national and regional conventions — and on the air," she recounted. "We wanted the events and experiences to be inclusive — something all members could participate in, if they wanted to."

To that end, every member had a point value in the Centennial QSO Party. And, recognizing that not everyone could come to the National Centennial Convention in Hartford, the League designated several regional Centennial conventions, so everyone would have an opportunity to participate. Convention forums, as well as information and articles in *QST* and in electronic media, provided something every member could learn from and enjoy, Craigie said.

"Because of the good work done by the ARRL Headquarters staff and a huge number of enthusiastic volunteers all over the country, the Centennial achieved those goals beyond what we were able to imagine," President Craigie said. "Thousands of ARRL members chased W1AW and worked each other across the bands and modes, having tremendous fun doing it. In QSOs and on their QSL cards, members told me how much they appreciate what the ARRL does for Amateur Radio."

President Craigie said that as the Centennial year played out, people were stopping by on her frequency just to say how much fun they'd had helping the League to celebrate its 100th anniversary. "One member said he had not been on HF for 20 years, but got back on HF for the Centennial. Another member said he thought the events have been a huge shot in the arm for Amateur Radio."

President Craigie logged more than 18,100 contacts during 2014, most of them by calling "CQ Centennial."

"For the first time in my life I was the most popular kid in school," she quipped. "To everybody: thanks for coming to the birthday party!"

ARISS Discusses Ham TV, Elects New International Officers

Amateur Radio on the International Space Station (ARISS) continues to explore the possibility of establishing a network of ground stations to enable the use of the Ham TV video system during ARISS school contacts. Mark Steiner, K3MS, updated the ARISS International team on the topic during its November meeting, conducted by teleconference. Kerry Banke, N6IZW, who works on ARISS hardware issues, reported that a document under development will detail the requirements to build a ground station. He and ARISS International Project Selection and Use Committee representative Lou McFadin, W5DID, have successfully received Ham TV transmissions. ARISS-EU President Gaston Bertels, ON4WF, has been working with European Space Agency (ESA) management to finalize the agreement that transfers custody of the Ham Video transmitter from ESA to ARISS. Steiner told the teleconference that more "blank" test transmissions could take place, once the custodial agreement is finalized.

ARISS 2015 – 2016 Officers (L-R) ARISS Vice-Chair Oliver Amend, DG6BCE, ARISS Secretary-Treasurer Rosalie White, K1STO, and ARISS Chair Frank Bauer, KA3HDO.

NASA Astronaut Mike Hopkins, KF5LJG, successfully installed and commissioned

the ARISS Ham Video system in March 2014. The system can transmit video of the crew and the interior of the *Columbus* module on the 2.4 GHz band (S-band).

During its November 18 teleconference, ARISS International delegates re-elected the current slate of officers for new 2-year terms starting on January 1, 2015. The incumbents are ARISS Chair Frank Bauer, KA3HDO, ARISS Vice-Chair Oliver Amend, DG6BCE, and ARISS Secretary-Treasurer Rosalie White, K1STO. In keeping with tradition, Canada's ARISS delegate Ian MacFarquhar, VE9IM, handled the election logistics.

ARRL Lab Receives a Major Upgrade, Thanks to Tektronix

The ARRL Laboratory now has significantly superior measurement capabilities, thanks to Tektronix Corporation's generous donation of a mixed-domain bench oscilloscope (model MDO4104B-3). Alan Wolke, W2AEW, Senior Applications Engineer for Tektronix, visited ARRL Headquarters on January 6 to introduce the Lab staff to the sophisticated scope. Wolke, an ARRL Life Member, arranged for the donation.

Tektronix Senior Applications Engineer Alan Wolke, W2AEW (center), demonstrates the new MDO4104B-3 oscilloscope to ARRL Test Engineer Bob Allison, WB1GCM (left), and ARRL Lab Manager Ed Hare, W1RFI. [Steve Ford, WB8IMY, photo]

"This oscilloscope is a huge benefit to us," commented ARRL Test Engineer Bob Allison, WB1GCM. "It will be particularly important, considering the fast-paced evolution of digital technology. The ARRL Lab is grateful to Tektronix, to Alan Wolke, and Tektronix Public Relations Manager Amy Higgins for this generous contribution."

The dual-function instrument has a bandwidth of 1 GHz, 5 GS/s for time-domain measurements, and can make frequency-domain measurements up to 3 GHz. The MDO4104B-3 replaces the Lab's Tektronix TDS-3052B, a 500 MHz storage oscilloscope.

Eastern Pennsylvania Starts New Year with New Section Manager

Joseph Ames, W3JY, of Malvern, Pennsylvania, became ARRL Eastern Pennsylvania Section Manager on January 1, completing the remaining term of former SM, Bob Famiglio, K3RF, the new ARRL Atlantic Division Vice Director.

ARRL Field Services and Radiosport Manager Dave Patton, NN1N, appointed Ames to succeed Famiglio after consulting with incoming ARRL Atlantic Division Director Tom Abernethy, W3TOM. Ames's SM appointment continues until March 31, 2016.

A ham since 1977 and an ARRL Life Member, Ames was an Assistant Section Manager in Eastern Pennsylvania from 2008 until 2014 and holds Official Emergency Station and Official Relay Station appointments. He is the new Eastern Area Staff Chair of the ARRL National Traffic System and also serves as net manager of the Eastern Pennsylvania Emergency Phone and Traffic Net and of the Pennsylvania Eastern Area RACES Net.

Nuts and Volts Magazine Launches New Ham Radio Column by Ward Silver, NØAX

In January, well-known ARRL Contributing Editor Ward Silver, NØAX, debuted his new column in *Nuts and Volts* magazine — "The Ham's Wireless Workbench." *Nuts and Volts* is written for "the hands-on hobbyist, design engineer, technician, and experimenter," which describes a great many radio amateurs.

"The general idea is to open the door to ham radio for electronically inclined folks who either may not be aware of the hobby or who may find some of our technology interesting and/or useful," Silver said. "This is an excellent opportunity to provide outreach to the active and growing electronic 'maker' — or do-it-yourselfer — audience."

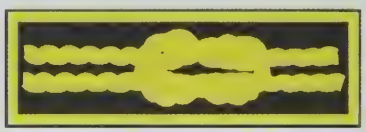
Every other month, Silver will cover a topic showcasing some aspect of Amateur Radio technology that is not typically covered by non-ham media. These could include such things as antennas, transmission lines, connectors, propagation, transmitters, and modulation. His first column, in the January 2015 issue, was an introduction to antennas.

Silver pointed to a new Amateur Radio Technology Portal (**www.arrl.org/tech-portal**) he developed for the ARRL website that offers links to some of the technical facets of Amateur Radio to those who may not be familiar with ham radio terminology. He said he's already received several e-mails through the site.

Ward Silver, NØAX.

Boy Scouts Recognize ARRL Amateur Radio Service to Scouting Award

The Boy Scouts of America's (BSA) National Awards and Recognition Committee has officially recognized the ARRL "Amateur Radio Service to Scouting Award" as part of its family of Community Organization awards. The ARRL award recognizes actively involved Scouting leaders who make a significant contribution to providing Scouts with a memorable and valuable Amateur Radio experience. Scouting leaders may wear the Community Organization Award square knot on their uniforms, in recognition of their service within their community organization.



"This is yet another step in ARRL-BSA cooperation, one that will recognize the Scouting leaders who have worked tirelessly to introduce the science, technology, fun, and excitement of Amateur Radio to the youth involved in Cub Scouting, Boy Scouting, and Venturing," the Boy Scouts said in announcing formal recognition of the League award.

The award was officially established through a resolution adopted by the ARRL Board at its 2013 Annual Meeting. It builds on the long-standing relationship between the BSA and ARRL, which began with the development of the Wireless Merit Badge in 1918 (now called the Radio Merit Badge). Nominations for the Amateur Radio Service to Scouting Award are made through the appropriate ARRL Section Manager.

Art Zygielbaum, KØAIZ, Appointed ARRL Midwest Division Vice Director

Art Zygielbaum, KØAIZ, of Lincoln, Nebraska, became Midwest Division Vice Director on January 1. ARRL President Kay Craigie, N3KN, appointed Zygielbaum to fill the vacancy created when incumbent Vice Director Rod Blocksome, KØDAS, was elected Midwest Division Director.

"Amateur Radio has given me a focus that informed and provided technical resources for my entire career," he said. "Accepting the Vice Director position is another way that I can give back to the hobby."

An ARRL Life Member, Zygielbaum served as Nebraska Section Manager from 2009 to 2013, and as a Midwest Division Assistant Director in 2013 and 2014. He is also a member of the Air Force Military Auxiliary Radio Service (MARS) and serves as Nebraska Deputy State AF MARS Director. He has been licensed since 1961. Zygielbaum will serve a 3-year term.

Midwest Vice Director Art Zygielbaum, KØAIZ. [Photo courtesy of Art Zygielbaum, KØAIZ]

Silent Keys

Past Northern Florida Section Manager Royal V. Mackey, N4ADI

Past ARRL Northern Florida Section Manager Royal V. "Roy" Mackey, N4ADI, of Winter Park, Florida, died December 5. He was 96 and had not been active as a radio amateur for several years. Mackey served as Northern Florida Section Manager from 1986 until 1990 and as a Northern Florida Assistant Section Manager from 1990 until 1997.

Mackey was instrumental in launching the Volunteer Examiner program in Central Florida. He was a member of the Quarter Century Wireless Association (QCWA).

"Roy's passing marks another of the Greatest Generation leaving our midst," said Paul Blumhardt, K5RT, a friend who got to know Mackey and his late wife Carolyn when he was a teenager. "Roy touched the lives of many in our Amateur Radio community, and he will be missed." — *Thanks to Paul Blumhardt, K5RT*

ARRL Roanoke Division Assistant Director, DXpeditioner Jim Wise, W4PRO

ARRL Roanoke Division Assistant Director and DXpeditioner Marion A. "Jim" Wise, W4PRO, of Virginia Beach, Virginia died December 31. He was 86. An ARRL Life Member, Wise was well known within the Tidewater Amateur Radio community.

Licensed in 1948 as W8YHV in his native Ohio, he served in the US Air Force during the Korean War, then worked for NASA until he retired in 1988. He was a part of regular special event ham operations from the museum battleship USS *Wisconsin* (N4WIS).

W4PRO belonged to the First-Class Operators Club, the A1 Operators Club, and the QCWA. He was involved in several DX operations from the 1970s until 2004. A CW aficionado, he was on the DXCC Honor Roll and had completed 5-Band DXCC and 160 Meter DXCC. Survivors include his wife Linda, W7PRO.

Contesting Hall of Famer Carl D. Cook, AI6V/P49V

Well-known contester, DXer, and DXpeditioner Carl Cook, AI6V/P49V (ex-WA6JUD), of Las Vegas, Nevada, died December 15. An ARRL Life Member, he was 74. On his QRZ.com web page, Cook recounted how he got into Amateur Radio in the 1970s, when he was 38, after installing an HF radio on his boat. He began listening on VHF, discovered VHF/UHF contesting, and got his Technician license. After upgrading to General in 1975, he enjoyed ARRL November Sweepstakes with the Northern California Contest Club, for which he also served a term as president.

In time, Cook developed into a world-class contester, and his operations from Aruba put Zone 9 into many logbooks. He said the highlight of his years in Amateur Radio was being named to the CQ Contest Hall of Fame in 1997. Cook was on the DXCC Honor Roll and held 5-Band DXCC. Survivors include his wife Sue, AI6YL/P4ØYL — *Thanks to John Bayne, KK9A/P4ØA*, and **QRZ.com**

Rick Palm, K1CE, k1ce@arrl.org

Power to the Public Service Operator

Choosing the right battery for your public service application — how to evaluate the pluses and minuses.

When radio amateurs head out into the field for supporting a public event with radio communications, our radios are the first thing we think of. But in reality, we need to be thinking of power sources, especially batteries, as well as radios. Without one, the other is useless. Often overlooked, batteries are mission-critical components, and it's good to review basic theory, needs, and applications now and then, which leads us to the subject of this month's column.

Watts, Amp-hours, and C-rates

If you look at your radio's specifications, listed in its operating manual, you will find information on how much current (amperage) the transmitter draws at various RF power levels (in watts) as well as when the radio is simply receiving. Also included will be voltage requirements.

I have an Icom 2200-H mobile FM transceiver. It requires a voltage of 13.8V ±15%. When transmitting at 65 W, the radio draws roughly 15 A, but when receiving at full volume, without any input signal, it draws only 1 A. This basic information indicates that you need a battery capable of delivering at least 15 A for a reasonable period. This relates to the battery's capacity measured in amp-hours (Ah).

For example, a 20 Ah battery should deliver 20 A for 1 hour, or 10 A for 2 hours, or 5 A for 4 hours, etc. This might be a suitable battery for my radio if I limit my transmitting. If during the course of an hour, I transmit at 65 W for a total time of 10 minutes, then my discharge rate is 15 A × (10 / 60) minutes, or 2.5 Ah. If the remaining time is spent receiving, we would add another 0.84 Ah to get a total of 3.34 Ah of discharge for each hour of operating. At that discharge rate, a 20 Ah battery should last for about 6 hours. It's important to keep in mind that no battery is 100% efficient, so your results may vary. Please consider the figures presented here as approximations.

The next battery characteristic that needs to be considered is the C-rate. The C-rate relates the capacity of the battery (in amp-hours) to the battery's discharge rate. The C-rate defines the continuous discharge current of the battery. So a 2 Ah battery with a 2C rating can be discharged at 4 A for 30 minutes or can be charged to full capacity by a 4 A current in 30 minutes. By the same turn, a 2 Ah battery with a 1C rating can be discharged at 2 A for 30 minutes, or can be charged to full capacity by a 2 A current in 30 minutes.

A final consideration is your radio's voltage tolerance. As I mentioned above, my mobile transceiver has a supply voltage specification of 13.8V ±15%. This means that to work properly, the radio requires a minimum supply voltage of 11.7 V. As a battery discharges its voltage will tend to fall. When it falls below 11.7 V, the radio may not operate properly, regardless of the battery's remaining capacity.

I also have an Icom IC-7000 HF radio. A look at the operating manual reveals that its current drain is 22 A at 100 W on transmit and a nominal 1.5 A on receive. Thus, if you plan on using this radio in the field operating at 100 W, you are going to need a battery with more capacity than the 20 Ah battery mentioned above.

Table 1
Output Power and Current Draw as a Function of IC-706MkII Power Setting

Setting	Power (W)	Current (A)
0	0	3.7
L	4	5.8
1	7	6.5
2	13	7.8
3	21	8.8
4	30	10
5	42	11.1
6	55	12
7	68	13
8	88	14.2
9	95	14.6
H	100	15.1

You will also need to consider the battery's maximum current output, and the fact that as a battery discharges, its voltage drops. As the voltage drops your radio's transmitter will have to draw more current, reducing the battery's amp-hour reserve.

You may want to experiment with your radio, and, when deciding on a battery to use for field operations, consider the power output you will need, current needed to support that output, and the transmit/receive duty cycle you will be operating.

Hand-held VHF/UHF radios require much less battery power, owing to their lower RF outputs. For HF, low-power rigs use much less power than 100 W rigs, even with the 100 W rig turned down to low-power levels, making them good options for field deployment. Smaller radios and batteries translate to more portability in the field. Hand-held radios usually come with a rechargeable battery pack. For back-up power, I always carry an alkaline battery holder/pack; these are generally reliable.

Battery Chemistry

While the above discusses theory and basic requirements for choosing a battery, there are also other critical decision points to address. The battery's chemical makeup, capacity, efficiency, size and weight (thus, portability into the field), shelf life or self-discharge rate, cycle life (number of charge/discharge cycles before the cell fails), and cost are all factors to consider.

Battery technology has advanced considerably over the years. Most of us are familiar with using nickel cadmium (NiCd) batteries for our handheld transceivers and sealed lead acid (SLA, or gel) cell batteries for our higher-power mobile VHF FM and HF ra-

dios, where greater capacity was required. Advances have brought us nickel-metal hydride (NiMH), lithium-ion (Li-ion), and lithium iron phosphate (LiFePO4) batteries.

NiCds were known for their long cycle life, high discharge rates (high output current), and low price. However, they had lower shelf life (higher self-discharge rates).[1] NiMH batteries have a better power density (power available per unit volume) than NiCds, but a lower cycle life and a lower peak output current.

Sealed lead acid (SLA), or gel cells, are used for higher-current power applications. Connected to a radio used primarily for receiving, they last a very long time. SLA batteries are larger and heavier than most other types, but because of their ability to source large currents for long periods they see frequent use in the field. They are staples at ARRL® Field Day. A typical gel cell has these specifications: nominal voltage 12 V; nominal capacity 7 Ah (7000 mAh); energy density 33 Wh per kilogram; a cycle life of 200 cycles; maximum discharge current 105 A; 6 × 2.5 × 3.5 inches in size and a weight of 5.5 pounds.

Lithium-Ion (Li-ion) is a relatively new technology that provides a much higher power density than SLA, NiCd, or NiMH batteries. The downside is that they require tight control of charge/discharge current and voltage.

Non-rechargeable alkaline batteries are another option, but it's important to minimize current drain as they have a steep discharge curve and lose voltage more rapidly than Li-ion or NiMH batteries. Lithium-type batteries are more expensive, but their flat discharge curve and higher capacity rating provides more operating time. NiMH batteries also have a flat discharge curve, like lithium cells, but a lower voltage. The advantage of NiMH cells is their lower price.

Lithium Iron Phosphate Batteries

I obtained a Lithium Iron Phosphate (LiFePO4) battery that was touted as being a good replacement for a gel cell. Let's look beyond the hype, and consider the specifications. The LiFePO4's working voltage is roughly the same, 12.8 V. Its size is about the same. Its capacity is 9 Ah, which is more, and its weight is about half the weight of the gel cell. Its cycle life is longer at more than 1000 charge/discharge cycles.

It sounds good until you compare the discharge ratings. The LiFePO4 battery's maximum discharge rating is 18 A versus 105 A for the gel cell — a critical difference, which can determine whether you can use the maximum RF power output of your HF rig or are limited to low-power levels.

I've been experimenting recently with a 20 Ah, 100 W maximum output LiFePO4 battery, which is relatively lightweight (8 pounds), and small (2 × 16 × 6 inches), and claimed to have a cycle life of thousands of cycles. It reportedly contains only 24 grams of lithium, making it suitable for carry-on air travel.

A typical Li-ion battery pack designed for use in a handheld transceiver. This pack can supply 7.252 W of power for 1 hour.

This battery has a 100 W maximum output, which means that for a radio that takes 13.8 V, it can draw a maximum current of only 7 A. To put this into perspective, see Table 1, which shows that an Icom IC-706MKIIG HF radio reached 10A at only 30 W RF output. Thus, this battery can power HF radios at low-power levels only.

A few more notes on Li-ion batteries: they feature higher discharge rates, higher power density, and lower self-discharge rates (shelf life). For safety and battery-life reasons, each battery pack is equipped with control circuitry to limit the peak voltage of each cell during the charge cycle, and to prevent the cell voltage from dropping too low during discharge. Most of these circuits also properly limit the charging and discharging current and monitor the cell temperature. Handle, use, and recharge Li-ion batteries with great care. Meticulously observe the polarity of the batteries and insert them properly in their chargers.

There are some major advantages of Li-ion batteries for use by radio amateurs. They can be recharged anytime during their entire discharge cycle, and they can be rapid-charged. In just 1 hour, they go from fully discharged to 80% of capacity, and are at 100% in just 2.5 hours. Another advantage of Li-ion is a highly predictable "remaining capacity" indication.

Batteries — Care and Feeding

Keep your batteries warm. A chemical reaction generates the battery's current. When cold, chemical reactions slow, the voltage drops, and less current is produced, making it harder for the battery to meet the current demand.

Pack and carry your batteries carefully, always making sure they are in insulated bags or containers. Don't drop them or otherwise damage them. Obey manufacturer's instructions for use.

Rechargeable Versus Alkaline Batteries

Rechargeable battery technology has evolved by leaps and bounds over time, but I would not totally rely on one if my life depended on it. I am a cave diver, which is a scuba diver who dives in underwater caves where there is no light whatsoever. I must have close to 100% reliability on the light source I bring with me, swimming into the cave for sometimes half a mile. If my light fails, I die. It's that simple.

Redundancy is essential: on dives, I bring a primary light with a rechargeable battery, and at least three other lights using new, non-rechargeable alkaline batteries. The life of rechargeable batteries comes to an end at some point. For peace of mind, and pursuant to universally accepted cave diving protocol and best practices, I use the alkaline batteries for what I consider to be improved reliability and hence, safety.

I recommend the same protocol for radio amateurs providing vital, potentially lifesaving radio communication services at earthquake disaster scenes or remote checkpoints in wilderness road rallies. Have redundant power sources, and have a supply of alkaline batteries. Obviously you're not going to be using them for high power applications, but for your handheld transceiver in the field, add an alkaline battery pack, or several, to your go-kit. I have one for my Icom V-80 handheld. I wouldn't leave home without it!

(Technical information contained in this article was edited and reviewed by my friend Eliot Mayer, W1MJ, BSEE, with thanks from the author).

[1]D. Gagnon, WB8HQS, "Which Battery Should You Use in Your Equipment?" *QST*, April 1999, pp 40 – 42.

Contest Corral — March 2015

Check for updates and a downloadable PDF version online at www.arrl.org/contests.

Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish Date-Time		Finish Date-Time		Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
27	2200Z	1	2200Z	1.8 / -	CQ WW 160 Meter SSB	Ph	RST and state/province or CQ zone	www.cq160.com
28	0000Z	1	2400Z	- / 2.3G	Worldwide EME Contest	Ph CW	TMO/RS(T) and "R"	www.dubus.org
28	1300Z	1	1300Z	3.5-28 / -	UBA Contest	CW	RS, serial, and ON province	www.uba.be/en/hf/contest-rules
28	1800Z	1	0600Z	3.5-28 / -	North American QSO Party RTTY	Dig	Name and S/P/C	www.ncjweb.com
1	1500Z	2	0059Z	3.5-28 / 50, 144	North Carolina QSO Party	Ph CW Dig	NC county or S/P/C, RS(T) optional	rars.org/ncqsoparty
2	1630Z	2	1730Z	3.5, 7 / -	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.memorial-ok1wc.cz
3	0200Z	3	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
3	1900Z	3	2100Z	3.5 / -	YL CW Party	CW	RST, serial, if YL "YL," name	www.agcw.de
4	1100Z	4	See website	1.8-28 / -	CWOps Weekly Mini-CWT Tests	CW	Name and member number or S/P/C	www.cwops.org/cwt.html
4	2300Z	5	See website	7,14 / -	John Rollins Memorial DX Contest	CW	RS, name, and S/P/C	www.antiquewireless.org
6	0145Z	6	0215Z	3.5-14 / -	NS Weekly RTTY Sprint	Dig	Serial, name, and S/P/C	www.ncccsprint.com
6	0230Z	6	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name, and S/P/C	www.ncccsprint.com
7	0000Z	8	2359Z	1.8-28 / -	ARRL Int'l Phone DX Contest	Ph	RS and state, province, or power	www.arrl.org/contests
7	1200Z	7	2359Z	1.8-28 / 50	Straight Key Weekend Sprintathon	CW	RST, QTH, name, member nr if member	www.skccgroup.com
7	1800Z	7	See website	1.8-28 / -	Open Ukraine RTTY Championship	Dig	Regional abbreviation and serial	uarl.com.ua/openrtty
14	1000Z	15	1000Z	3.5-28 / -	RSGB Commonwealth Contest	CW	RST and serial (Commonwealth only)	www.rsgbcc.org
14	1400Z	14	2000Z	3.5-28 / -	AGCW QRP Contest	CW	RST, serial, class, AGCW number or NM	www.agcw.de
14	1400Z	15	0200Z	1.8-28 / 50,144	Louisiana QSO Party	Ph CW Dig	Call sign, RS(T), LA parish or S/P/C	laqp.org
14	1500Z	14	1800Z	3.5-28 / -	QRP ARCI Spring Digital Sprint	Dig	RST, 4-char grid square, QRP ARCI nr or power	www.qrparci.org/contests
14	1600Z	15	1600Z	3.5-28 / -	EA PSK63 Contest	Dig	RST and serial or EA province	www.ure.es
14	1800Z	15	0800Z	3.5 / -	Tesla Memorial HF Contest	CW	RST, serial, and 4-char grid square	www.radiosport.org.rs/HFTeslaMemorial
14	1800Z	15	1800Z	1.8-28 / 50	QCWA Spring QSO Party	Ph CW Dig	Call,year lic'd,name,QCWA chap or S/P/C	www.qcwa.org/qso-party.htm
14	1900Z	15	1900Z	3.5-28 / -	Idaho QSO Party	Ph CW Dig	RS(T) and ID county or S/P/C	www.idahoarrl.info/qsoparty
15	0000Z	15	0359Z	3.5-14 / -	North American RTTY Sprint	Dig	Both call signs, serial, name, and S/P/C	www.ncjweb.com
15	1800Z	16	0100Z	3.5-28 / 50+	Wisconsin QSO Party	Ph CW Dig	WI county or S/P/C	www.warac.org
16	0200Z	16	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
17	1700Z	18	See website	3.5-28 / -	CLARA Chatter Party	Ph CW	Call sign, RS(T), name, and S/P/C	www.clarayl.ca
19	0030Z	19	0230Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
21	0200Z	22	0200Z	3.5-28 / -	BARTG HF RTTY Contest	Dig	3-digit serial and 4-digit time	www.bartg.org.uk
21	1200Z	22	1159Z	1.8-28 / -	Russian DX Contest	Ph CW	RS(T), serial or oblast abbr	www.rdxc.org
21	1300Z	22	See website	3.5-28 / 50	Oklahoma QSO Party	Ph CW Dig	RS(T) and OK county or S/P/"DX"	www.k5cm.com/okqp.htm
21	1400Z	22	See website	1.8-28 / 50-440	Virginia QSO Party	Ph CW Dig	Serial and VA county/city or S/P or "DX"	www.qsl.net/sterling
21	1700Z	21	1900Z	1.8-28 / 50	Feld-Hell Leprechaun Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
28	0000Z	29	2359Z	1.8-28 / 50+	FOC QSO Party	CW	RST, name, FOC nr if member	www.g4foc.org
28	0000Z	29	2359Z	1.8-28 / -	CQ WPX SSB Contest	Ph	RS and serial	www.cqwpx.com
28	0000Z	29	2400Z	- / 3.4G	Worldwide EME Contest	Ph CW	TMO/RS(T) and "R"	www.dubus.org

All dates refer to UTC and may be different from calendar dates in North America. Times given as AM or PM are local times and dates. No contest activity occurs on the 60, 30, 17, and 12 meter bands. Serial = Sequential number of the contact. S/P/C = State, Province, DXCC Entity. XE = Mexican state. Publication deadline for Contest Corral listings is the first day of the second month prior to publication date (December 1 for February *QST*) — send information to **contests@arrl.org**. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QST is the minute listed in the "Finish Time" column.

IARU HF Championship 2014

Close races, World Radiosport Team Championships, and great conditions — records fell!

Nate Moreschi, N4YDU, n4ydu@yahoo.com

Held during the second weekend of July (July 12 – 13, 2014), the IARU contest offers quite a bit of summer fun. Not only can you work on your CW and SSB skills, there are also multiple categories for various power levels and mode options. Chasing HQ stations increases excitement, and adding to the intrigue is the unpredictability of summer propagation. Whether you are searching for multi-hop sporadic E layer openings on the high bands, looking for polar openings at night on 20 meters, or working through the noise on the low bands, there's plenty to chase!

The Canadian Headquarters Station — VY2RAC

The IARU contest features special entries known as "Headquarters" — or "HQ" — stations representing national IARU organizations. Unique to each country, a typical HQ station racks up thousands of QSOs, makes multiplier chasers happy, and is staffed with many operators. This past summer, the short-staffed trio of Matt, KØBBC; Ron, NØAT, and Tony, VE3RZ, put in a fantastic effort from the powerful VY2TT station on Prince Edward Island to hand out the much-appreciated RAC mult. The group racked up more than 6000 contacts to put smiles on the faces of many contesters, including the buzzing WRTC teams nearby in Boston.

After attending to a few station needs to make it ready for the three-person multi-multi squad, the team was ready for the big time action — and they got it. From NØAT's article in the Twin City DX Association's newsletter (**www.tcdxa.org**): "Having that much horsepower and being a new multiplier generated unlimited pileups. We could work each station on six bands and both modes."

The idea came from a big desire to operate from VY2TT during the IARU event. While the contest doesn't have a Multioperator, Multitransmitter (MM) category, the operators wanted more time in the operating chair and decided to move forward with the request to operate as an HQ station. VE3KI and VO1DK made the HQ operation possible. (HQ and the related Administrative Council station results are tabulated separately from the main results.)

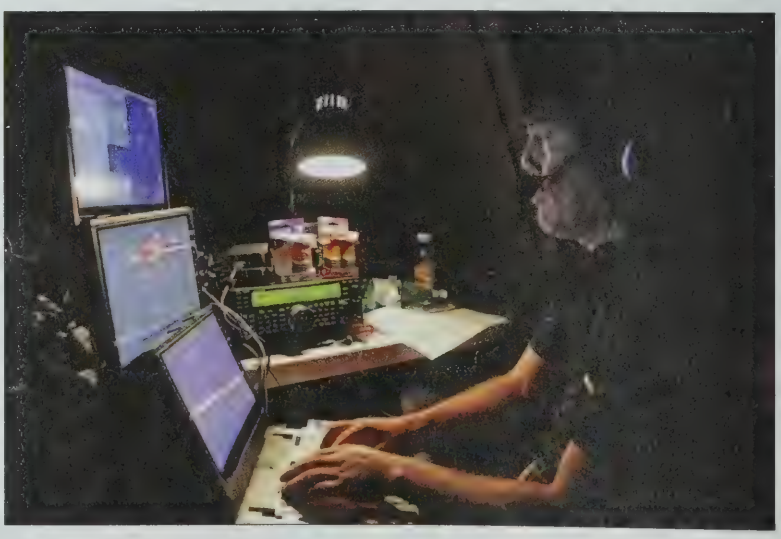
WRTC2014 Results

Four years of serious preparation paid off in New England as a record 59 teams competed in the exceptionally well-run World Radiosport Team Championship (WRTC) in Boston. The organizers can now relax after putting together a flawless effort, which required an intense amount of planning. The eventual champions (the K1A team of N6MJ and KL9A) grabbed the lead after the first hour and never looked back as they secured their first championship after finishing 3rd in WRTC2010 in Russia. The talented team received an automatic bid to WRTC2018, which will be held in Germany (**www.wrtc2018.de/en**). Rounding out the top three in the 2014 event were the Slovakian team of OM3GI and OM3BH, and the German team, DJ5MW and DL1IAO. Accuracy paid off for DJ5MW and DL1IAO as their incredible 1% error rate vaulted them from 5th to 3rd place in the final standings. Amazingly, 60% of the

IARU Member Society Headquarters Stations

Headquarters and Administrative Council station scores were tabulated by the World Wide Radio Operator's Federation (**www.wwrof.org**) and are listed in *QST* as a courtesy to the Amateur Radio community.

Call	Score	Call	Score
TMØHQ	34,506,131	CX1AA	3,943,739
EF4HQ	31,641,120	T49C	3,604,265
DAØHQ	30,102,280	VP9HQ	3,395,748
R3HQ	26,608,000	YV5AJ	2,252,130
SNØHQ	26,327,673	ES9A	2,227,159
IIØHQ	25,564,392	ZS9HQ	1,749,720
GR2HQ	25,427,236	ZL6HQ	1,627,988
OL4HQ	25,402,167	7TØHQ	1,490,032
9AØHQ	23,362,762	ZF1A	1,294,528
YTØHQ	22,583,934	YEØHQ	1,232,742
S5ØHQ	20,878,765	DXØHQ	1,134,840
LZ7HQ	18,873,175	ZP5AA	
YRØHQ	17,862,897	(LU8EOT, op)	930,328
SK9HQ	16,956,911	9Y4HQ	752,370
AZØHQ	15,422,316	EIØHQ	
LYØHQ	15,267,995	(EI6JK, op)	588,200
HB9HQ	14,576,771	HS5ØRAST	
E7HQ	14,525,004	(HS5NMF, op)	458,040
OZ1HQ	14,343,930	9M4DXX	
OE1A	13,419,870	(9M2TO, op)	390,450
OPØHQ	12,435,780	OA4O	351,917
PA6HQ	11,887,200	XE1LM	226,848
W1ØØAW	10,451,520	VK5WIA	214,240
ZW2HQ	10,050,156	TGØAA	
V55HQ	9,956,010	(TG9ANF, op)	192,696
EM5HQ	9,555,953	HQ2W	
YL4HQ	9,446,745	(HR2DMR, op)	167,970
NU1AW	8,636,498	V84O	147,000
SXØHQ	8,606,307	JU1HQ	
CR5HQ	6,916,875	(JT1DA, op)	130,327
VY2RAC	6,884,769	TC1HQ	88,200
8NXHQ	6,838,741	XR3HQ	62,640
UN1HQ	6,758,310	HD2A	
OH2HQ	6,429,060	(HC2AO, op)	8,294
LI2HQ	6,080,250	HI8RCD	
Z3ØHQ	5,230,872	(HI8KW, op)	1,980
ER7HQ	4,569,084		



Showing the intensity and focus typical of all WRTC teams, K1O team member "Don," JH5GHM (his teammate was Hajime, JA1OJE), works stations on 80 meter CW. The team finished with 3305 QSOs during the 24-hour contest. [Kristjan Kodermac, S5ØXX, photo]

Top Ten — US and Canada

Single Operator, Mixed Mode, QRP

KØOU	231,870
NA4CW	87,138
KT8K	45,140
KU4A	19,320
K8ZT	17,298
K1LT	9,835
KC5WA	7,920
W4DFG (W1TEF, op)	2,781
AF9J	1,088
NN7SS (K6UFO, op)	996

Single Operator, Mixed Mode, LP

AA4NC	1,104,495
N5DO	798,930
N5ZC	707,460
KU8E	683,000
K9OM	657,845
N4OX	645,120
VE3BR	624,792
WØDLE	544,765
KØAD	420,046
W6AWW	361,921

Single Operator, Mixed Mode, HP

KQ2M	3,785,940
VE3AT	3,222,115
K6XX	3,045,750
W2FU (N2ZN, op)	2,437,358
WØEWD (@NØNI)	1,653,093
K4AB	1,648,992
K3ZO	1,548,072
WO4O	1,430,702
W1WMU	1,412,580
VE3OI	1,333,150

Single Operator, Phone Only, QRP

W6QU (W8QZA, op)	78,078
NT4TS	61,544
WBØIWG	7,200
N4ZAK	5,472
K7RLL	3,432
KK6RF	2,684
AB3RW	2,673
K9JK	1,302
KK7VL	876
VE5DLD	448

Single Operator, Phone Only, LP

N1UR	882,336
KT4ZB	265,950
VE1WOW (K1WO,op)	204,672
W4FT	197,349
VE3VE	162,500
K6GHA	153,034
VA3GKO	144,353
N9DFD	133,168
HI3K	129,528
K5DHY	128,340

Single Operator, Phone Only, HP

W7WA	1,851,816
K5LLA	717,500
AD5XD	635,318
WA5OYU	556,248
K5ER	537,119
W6AFA	385,402
VE7SZ	363,924
N5MV	341,824
KØRH	321,195
KK7YC	293,248

Single Operator, CW Only, QRP

VA3SB	256,818
K8CN	228,200
N7IR	157,398
K3TW	51,798
AC8AP	51,392
W1WBB	28,860
K9JWV	27,750
N1RU	25,956
AI9K	15,662
KØMP	15,365

Single Operator, CW Only, LP

W4IX	1,151,955
W1RM	1,132,203
K7SV	1,054,144
NA8V	783,450
W1NN	771,274
WJ9B	747,285
K1IMI	688,524
WB4TDH	670,662
VE1RGB	596,778
W7YAQ	590,472

Single Operator, CW Only, HP

AA3B	2,897,100
VE3JM	2,767,694
N4OGW	2,120,676
VA2EW	2,090,848
WØUA	1,963,704
K7GM	1,853,670
K3EL	1,530,816
K9CT	1,445,026
N5XZ	1,439,465
K2SSS	1,383,824

Multioperator

K5TR	2,817,848
KD4D	2,570,425
W3UA	2,435,028
K5RX	2,094,400
N1LN	1,942,655
N3RS	1,919,148
WW4LL	1,792,792
K5RT	1,728,396
KD2RD	1,329,333
VE7ZO (@VE7UF)	1,283,469

Top Ten — World-Wide

Single Operator, Mixed Mode, QRP

DK3WE	654,408
UT5UN	443,016
OK7CM	433,020
SP5DDJ	325,251
KØOU	231,870
US2IZ	202,583
9A2EY	184,832
LZ5QZ	142,800
IZ8JFL	130,686
DL6OCH	122,952

Single Operator, Mixed Mode, LP

MWØEDX	1,890,312
PS2T (PY2NY, op)	1,859,872
LY6A	1,225,733
AA4NC	1,104,495
RA9AP	1,004,394
UR6EA	891,880
7Z1SJ	865,536
R7MM	851,075
N5DO	798,930
YT2AAA	797,268

Single Operator, Mixed Mode, HP

EF8U (EA8RM, op)	4,534,184
UW1M	4,023,788
A65BP	3,974,580
KQ2M	3,785,940
KP3Z (NP4Z, op)	3,351,600
UPØL	3,253,104
VE3AT	3,222,115
K6XX	3,045,750
OH6LI	2,848,225
EU1A	2,842,775

Single Operator, Phone Only, QRP

FY5FY	1,074,258
DL8LR	371,209
HA5NB	310,980
DKØTC (DL1APQ, op)	155,848
SP7VTQ	113,918
UR5IPW	108,429
US5ZCW	98,905
W6QU (W8QZA, op)	78,078
HB9EGA	62,048
NT4TS	61,544

Single Operator, Phone Only, LP

EA8MT	1,964,314
UX9Q (UR9QQ, op)	1,602,992
EI1A (ON4EI, op)	1,347,192
HA3DX (HA4XH, op)	1,296,625
EE7Y (EA7ISH, op)	1,085,088
YV1KK	1,023,400
RA3Y	890,813
N1UR	882,336
KP2/AA1BU	834,426
G3VAO	736,296

Single Operator, Phone Only, HP

CN2R	5,203,660
5B4AIF	3,691,008
PJ4DX	2,726,205
H2T (5B4XF, op)	2,684,640
HG8R (HA8JV, op)	2,494,570
IW2HAJ	2,192,226
IKØPHY	2,171,430
ES5RW	2,169,490
RJ4P	2,115,840
ED8W	2,030,072

Single Operator, CW Only, QRP

UC7K	531,180
LZ2RS	405,790
UA8AA	316,840
DD1IM	271,852
VA3SB	256,818
K8CN	228,200
DL4SDW	179,655
UX2MF	171,684
UA1CUR	157,480

Single Operator, CW Only, LP

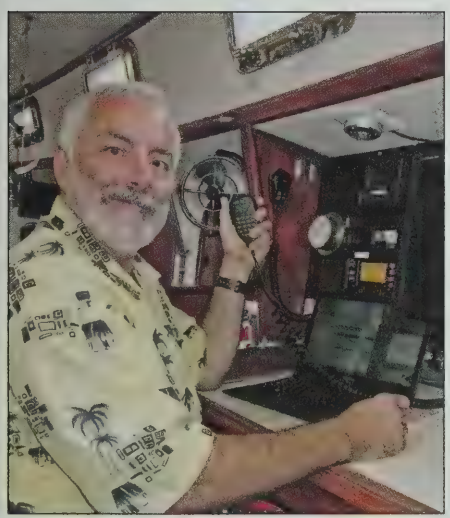
LY5R	1,523,319
IO4T	1,419,075
UA3RF	1,360,510
WP3C	1,346,730
W4IX	1,151,955
W1RM	1,132,203
DD5M (DJØZY, op)	1,092,168
YR9F (YO9FNP, op)	1,077,858
K7SV	1,054,144
SP4JCQ	1,049,489

Single Operator, CW Only, HP

P3F (5B4AGN, op)	4,103,834
UA5C	3,330,360
6V7S	3,130,668
RG6G	2,936,848
AA3B	2,897,100
VE3JM	2,767,694
OH1F (OH1TM, op)	2,631,930
OQ5M (ON5ZO, op)	2,391,347
OG2P (OH2PM, op)	2,385,216
RT5Z (RA3CW, op)	2,347,048

Multioperator

RM9A	4,576,196
CR3T	4,317,392
UA4M	4,087,280
HG1S	3,936,845
HG7T	3,819,202
UR7GO	3,362,115
DL2CC	3,301,812
IR8C	3,142,731
K5TR	2,817,848
SP8R	2,791,565



Adam, K7ST/mm, operated aboard the *Bravo*, loading up an insulated backstay, putting Zone 56 in more than 150 logs. Adam and Cindy, KF7UPI, have been sailing the Pacific for a couple of years with ham radio never far away. [Cindy Brennan, KF7UPI, photo]

contacts made during the event were cross-checked in just a 6-hour log-submission window for non-WRTC competitors. Competitors had only a 30-minute window to submit their logs to the event's judging team.

New Records in 2014

While many were focused on the outcome of the World Radiosport Team Championships that ran simultaneously with the contest, many others had their hopes set on grabbing some glory for themselves. With solid HF conditions and increased participation, a total of 42 records were set during the 2014 running of the IARU HF Championship.

The records ranged from new all-time high scores in the HQ category by TMØHQ and for Single Operator, High Power (SOHP) SSB category, by CN2R from ITU zone 37, to a new record set by AL4Y with just three points in the Single Operator, Mixed Mode, Low Power category for Zone 1.

While CN2R's all-time mark is quite impressive, there were several other impressive record-setting performances. Among them are new W/VE marks for Single Operator, Mixed Mode: for High Power by KQ2M and for US Low Power by AA4NC. Also of note from around the globe were outstanding performances by VE3AT, VE3JM, W7WA, WJ9B, K5TR, AA3B, W4IX, EA8MT, A65BP, JS3CTQ, VK2DX, and HSØZKX. All of these stations set new zone records. These and more records can be found online at **arrl.org/contest-records**. All IARU records were recently updated by a talented group of volunteers including K3WA, N3ND, EA4ZK, N1RR, AB1J, N5KM, and N1JM.

Close Races

When looking back on a contest, it becomes easy to question a decision or period in which one may have relaxed too much, made a bad decision, or just goofed up in a way that may

W/VE Region Leaders

Table shows Call, Mode, Power, and Score

Northeast Region
(New England, Hudson, and Atlantic Divisions; Maritime and Quebec Sections)

K1LT	Mix	QRP	9,835
NQ2T	Mix	QRP	404
VE2AWR	Mix	LP	210,328
WA2JQK	Mix	LP	143,184
KB1HNZ	Mix	LP	141,372
KQ2M	Mix	HP	3,785,940
K6XX	Mix	HP	3,045,750
W2FU (N2ZN, op)			
	Mix	HP	2,437,358
AB3RW	Ph	QRP	2,673
N1UR	Ph	LP	882,336
VE1WOW (K1WO, op)			
	Ph	LP	204,672
KA2KON	Ph	LP	99,064
K1PLX	Ph	HP	261,136
WA1NPZ	Ph	HP	207,360
K2JMY	Ph	HP	77,100
K8CN	CW	QRP	228,200
W1WBB	CW	QRP	28,860
WK2T	CW	QRP	8,052
W1RM	CW	LP	1,132,203
K1IMI	CW	LP	688,524
VE1RGB	CW	LP	596,778
AA3B	CW	HP	2,897,100
VA2EW	CW	HP	2,090,848
K3EL	CW	HP	1,530,816
KD4D	Multi	HP	2,570,425
W3UA	Multi	HP	2,435,028
N3RS	Multi	HP	1,919,148

Southeast Region
(Delta, Roanoke, and Southeastern Divisions)

NA4CW	Mix	QRP	87,138
KC5WA	Mix	QRP	7,920
W4DFG (W1TEF, op)			
	Mix	QRP	2,781
AA4NC	Mix	LP	1,104,495
KU8E	Mix	LP	683,000
N4OX	Mix	LP	645,120
K4AB	Mix	HP	1,648,992
WO4O	Mix	HP	1,430,702
N8II	Mix	HP	1,122,160
NT4TS	Ph	QRP	61,544
N4ZAK	Ph	QRP	5,472
KT4ZB	Ph	LP	265,950
W4FT	Ph	LP	197,349
N9DFD	Ph	LP	133,168
WA5OYU	Ph	HP	556,248
K5ER	Ph	HP	537,119
KA8Q	Ph	HP	114,000
K3TW	CW	QRP	51,798
K4MF	CW	QRP	14,960
N2WN	CW	QRP	10,076
W4IX	CW	LP	1,151,955
K7SV	CW	LP	1,054,144
WB4TDH	CW	LP	670,662
N4OGW	CW	HP	2,120,676
K7GM	CW	HP	1,853,670
N4ZZ	CW	HP	1,341,198
N1LN	Multi	HP	1,942,655
WW4LL	Multi	HP	1,792,792
N6AR	Multi	HP	621,150

Central Region
(Central and Great Lakes Divisions; Ontario Section)

KT8K	Mix	QRP	45,140
KU4A	Mix	QRP	19,320
K8ZT	Mix	QRP	17,298
K9OM	Mix	LP	657,845
VE3BR	Mix	LP	624,792
N8VV	Mix	LP	211,640
VE3AT	Mix	HP	3,222,115
VE3OI	Mix	HP	1,333,150
WR9D (KB9UWU, op)			
	Mix	HP	1,037,321
K9JK	Ph	QRP	1,302
VE3VE	Ph	LP	162,500
VA3GKO	Ph	LP	144,353
VE3MV	Ph	LP	96,798
KE8FT	Ph	HP	212,220
AJ4A	Ph	HP	146,016
VA3ZNQ	Ph	HP	106,862
VA3SB	CW	QRP	256,818
AC8AP	CW	QRP	51,392
N1RU	CW	QRP	25,956
NA8V	CW	LP	783,450
W1NN	CW	LP	771,274
KV8Q	CW	LP	480,006
VE3JM	CW	HP	2,767,694
K9CT	CW	HP	1,445,026
N8BJQ	CW	HP	769,699
NV9L	Multi	HP	1,067,840
K8BL	Multi	HP	382,158
K8PGJ	Multi	HP	335,750

Midwest Region
(Dakota, Midwest, Rocky Mountain, and West Gulf Divisions; Manitoba and Saskatchewan Sections)

KØOU	Mix	QRP	231,870
N5DO	Mix	LP	798,930
N5ZC	Mix	LP	707,460
WØDLE	Mix	LP	544,765
WØEWD (@NØNI)			
	Mix	HP	1,653,093
KØBJ	Mix	HP	490,000
KO7X	Mix	HP	415,467
WBØIWG	Ph	QRP	7,200
VE5DLD	Ph	QRP	448
K5DHY	Ph	LP	128,340
N7MZW	Ph	LP	116,154
W5GFI	Ph	LP	89,864
K5LLA	Ph	HP	717,500
AD5XD	Ph	HP	635,318
N5MV	Ph	HP	341,824
K9JWV	CW	QRP	27,750
NØHOT	CW	QRP	3,920
KA8HDE	CW	QRP	1,924
W5ZO	CW	LP	408,240
NAØN	CW	LP	395,008
W5RYA	CW	LP	251,129
WØUA	CW	HP	1,963,704
N5XZ	CW	HP	1,439,465
WD5K	CW	HP	630,416
K5TR	Multi	HP	2,817,848
K5RX	Multi	HP	2,094,400
K5RT	Multi	HP	1,728,396

West Coast Region
(Pacific, Northwestern, and Southwestern Divisions; Alberta, British Columbia, and NWT Sections)

NN7SS (K6UFO, op)			
	Mix	QRP	996
W6AWW	Mix	LP	361,921
NN6CH	Mix	LP	307,436
WA6FGV	Mix	LP	302,016
K6LA	Mix	HP	1,244,310
N6NF	Mix	HP	447,120
N6MI	Mix	HP	376,090
W6QU (W8QZA, op)			
	Ph	QRP	78,078
K7RLL	Ph	QRP	3,432
KK6RF	Ph	QRP	2,684
K6GHA	Ph	LP	153,034
HI3K	Ph	LP	129,528
K7MK	Ph	LP	78,795
W7WA	Ph	HP	1,851,816
W6AFA	Ph	HP	385,402
VE7SZ	Ph	HP	363,924
N7IR	CW	QRP	157,398
KØMP	CW	QRP	15,365
NX1P	CW	QRP	8,814
WJ9B	CW	LP	747,285
W7YAQ	CW	LP	590,472
K7WP	CW	LP	431,406
NI6W (W4EF, op)			
	CW	HP	669,992
N6MA	CW	HP	579,411
K6NR	CW	HP	578,344
VE7ZO (@VE7UF)			
	Multi	HP	1,283,469
K6MMM	Multi	HP	957,504
NX6T	Multi	HP	930,748

have cost a spot in the final standings. Close races lead to even more head-scratching!

Take, for example, the Single Operator, CW, Low Power, W/VE battle. W4IX (1,151,955) of South Carolina is no stranger to high-placing finishes. He nipped W1RM from Connecticut (1,132,203) by just 1.7 % to take the top prize. Let's not leave out the strong effort from K7SV in Virginia in the same category. Larry tallied 1,054,144 for 3rd place.

Also of note, MWØEDX drove his station to 1,890,312 points, holding off the hard-charging performance of PS2T (PY2NY op, 1,859,872) for the top world slot in the Single Operator, Mixed Mode, Low Power race. That's a paltry difference of 1.6 %.

CW enthusiasts who decided to go the High Power route produced a grand fight for a top spot on the world stage. In the end, it was P3F (5B4AGN op) copying his way to a score of just over 4 million points. While Bob knocked off 6V7S (RK4FF op) by nearly 1 million points, the QSO counts were close as 6V7S collected 3054 and P3F logged 2962. Also of note in the QSO count were 3rd and 4th place finishers AA3B and VE3JM who finished with 2936 and 3069 (the highest contact total before log-checking), respectively. More tight races, such as those between RM9A and CR3T, as well as among VA3SB, K8CN, AA3B, and VE3JM, are covered in the full results, which are published online.

Continental Leaders

Table shows Call, Category, Power, and Score

Africa

EA8AQV	Mix	LP	56,388
EF8U (EA8RM, op)	Mix	HP	4,534,184
EA8MT	Ph	LP	1,964,314
CN2R	Ph	HP	5,203,660
CN8KD	CW	LP	261,855
6V7S	CW	HP	3,130,668
CR3T	Multi	HP	4,317,392

Asia

JK1TCV	Mix	QRP	23,840
RA9AP	Mix	LP	1,004,394
A65BP	Mix	HP	3,974,580
JA2MWV	Ph	QRP	9,776
UA9R	Ph	LP	456,960
5B4AIF	Ph	HP	3,691,008
UA8AA	CW	QRP	316.840
RX9AF	CW	LP	806,912
P3F (5B4AGN, op)	CW	HP	4,103,834
RM9A	Multi	HP	4,576,196

Europe

DK3WE	Mix	QRP	654,408
MW0EDX	Mix	LP	1,890,312
UW1M	Mix	HP	4,023,788
DL8LR	Ph	QRP	371,209
UX9Q (UR9QQ, op)	Ph	LP	1,602,992
HG8R (HA8JV, op)	Ph	HP	2,494,570
UC7K	CW	QRP	531,180
LY5R	CW	LP	1,523,319
UA5C	CW	HP	3,330,360
UA4M	Multi	HP	4,087,280

North America

AL2F	Mix	LP	45,828
KP3Z (NP4Z, op)	Mix	HP	3,351,600
NP3RE	Ph	QRP	39,760
KP2/AA1BU	Ph	LP	834,426
XE1B	Ph	HP	694,500
CO2IR	CW	QRP	31,320
WP3C	CW	LP	1,346,730
XE1MM	CW	HP	51,957
6Y3M	Multi	HP	1,959,776

Oceania

YBØANN	Mix	QRP	430
YB2LSR	Mix	LP	35,150
YB4IR	Mix	HP	540,792
VK4ATH	Ph	QRP	462
DV1JM	Ph	LP	145,040
YB2DX	Ph	HP	604,920
KH6/W8RU	CW	QRP	33
KH6CJJ	CW	LP	246,960
VK2DX	CW	HP	1,316,406
KH6LC	Multi	HP	1,984,338

South America

PS2T (PY2NY, op)	Mix	LP	1,859,872
YV6CR	Mix	HP	358,940
FY5FY	Ph	QRP	1,074,258
YV1KK	Ph	LP	1,023,400
PJ4DX	Ph	HP	2,726,205
LU3VA	CW	QRP	36,972
PR7AB	CW	LP	601,290
PY2NA	CW	HP	624,568
PP5WG	Multi	HP	2,268,888

HQ and Administrative Council Results

Any new DXer looking to add entities to his or her DXCC band totals had plenty of opportunity during the contest. The European HQ stations were, as usual, out in force. Taking the top HQ spot this time around was TMØHQ, followed by EF4HQ, DAØHQ, R3HQ, and SNØHQ.

The IARU Administrative Council (AC) stations provide a little extra excitement because they, too, count as multipliers. KK1Z was tops overall and in Region 2 with over 3 million points. The NB2T group operated from

IARU Administrative Council Stations

Category	Call	Score
AC	VC6IARU	73,395
R1	NB2T (@K6ND)	1,988,520
R1	OK8JOE	13,616
R1	LZ1US	2,106
R1	DF3IAL	1,148
R2	KK1Z	3,111,516
R2	PT2ADM	789,760
R3	YBØAZ	582,736
R3	JA1CJP	261,188

K6ND for the top spot from Region 1 and was second overall with just under two million points. Rounding out the top three was PT2ADM with 789K points from Brazil.

Soapbox Musings

Reading through the post-contest soapbox entries offers quite a bit of perspective on the event. While WRTC participants were pouring every ounce of radiosport know-how into the event, others were either celebrating birthdays, chasing wallpaper or plaques, just trying to work what they heard, or simply experiencing the thrill of making contacts.

Perhaps one of the more interesting outings was the effort of K7ST, who was maritime mobile in the waters of Fiji (ITU Zone 56). Adam and his wife, Cindy, KF7UPI, were in the midst of a Pacific cruise on his sailboat, *Bravo*, and he decided to hand out Zone 56. Signing K7ST/mm apparently threw off several operators but he managed 156 contacts with 100 W and a wire. From Adam's soapbox:

No one stopped for a minute during WRTC2014! The N1M team of Fred, K9VV, and John, VE3EJ, were in the final third of the contest as the Moon rose over their Boston-area Field Day-style station. [Danny Pease, NG9R, photo]

> Wow, what an exercise in frustration. Using /mm instead of /3D2 since no Fiji license, and I was at sea in Zone 56... Nearly every one of the 156 Qs challenged the zone, telling me I was in Zone 6. Couldn't get any rate going with 100 W and a random length wire (insulated backstay on the boat), even with the Zone 56 "amplifier effect..." Great contest, though, and those WRTC ops (the few I could hear) were doing a great job. All sounded very equal from down under.

A lot of the soapbox comments were related to the abilities shown by the WRTC operators. Many stations were busy hunting down all 59 teams for a shot at the available prizes as well as extra points for the ARRL Centennial QSO Party. K2PS, who was chasing the 1 × 1 WRTC participants, had this to offer:

> Working all those great WRTC ops was amazing. My sigs were pretty weak with LP and only a 40 meter dipole, up about 12 – 15 feet. But every WRTC station copied me somehow (at least on CW), where much louder Zone 8 stations CQed in my face. Congrats to them all!

Next Year

While the current solar cycle was slow to start, it has provided very solid HF conditions during the past 2 years, and hopefully the Sun will produce a few more exciting events for contesters before it slowly goes to rest. The 2015 IARU contest is scheduled for July 11 and 12. Start planning now, because it is just a few months away. Set your sights on a new personal goal, a certificate, a plaque, a new all-time record, or simply just to have a blast!

Records Set in 2014

Zone	Category	Power	Call	Score	Location
All-Time Category Record					
37	Ph	HP	CN2R	5,338,937	Morocco
Zone Record					
1	Mix	LP	AL4Y	3	Alaska
1	Mix	LP	AL4Y	3	Alaska
3	Ph	QRP	K7MQL/VE4 (K7MQL, op)	420	Manitoba
3	Mult	HP	VE4EA (VE4EA, VE4SNA, VE4DRK)	615,330	Manitoba
4	Mix	HP	VE3AT	3,337,500	Ontario
4	Ph	LP	VA3GKO	187,680	Ontario
4	CW	HP	VE3JM	2,878,888	Ontario
4	CW	QRP	VA3SB	288,267	Ontario
6	Ph	HP	W7WA	1,869,020	Western Washington
6	Ph	LP	K6GHA	165,927	Santa Clara Valley
6	Ph	QRP	W6QU (W8QZA, op)	79,120	San Diego
6	CW	LP	WJ9B	816025	Idaho
6	CW	QRP	N7IR	157509	Arizona
7	Mix	QRP	KØOU	246074	Missouri
7	Ph	LP	K5DHY	133,985	Kansas
7	Ph	QRP	KC5R	172,080	North Texas
7	Mult		K5TR (K5PI, K5TR)	2,910,467	South Texas
8	Mix	HP	KQ2M	4,071,018	Connecticut
8	Mix	LP	AA4NC	1170792	North Carolina
8	CW	HP	AA3B	2,969,421	Eastern Pennsylvania
8	CW	LP	W4IX	1,190,462	South Carolina
33	CW	QRP	BA2BI	9,509	China
36	Ph	LP	EA8MT	2,004,750	Canary Islands
37	Ph	HP	CN2R	5,338,937	Morocco
39	Mix	HP	A65BP	4,192,244	United Arab Emirates
43	Mix	HP	BD9XE	353,668	China
45	Mix	LP	JR4GPA	403,191	Japan
45	CW	LP	JI1RXQ	539,790	Japan
45	Mult	n/a	JS3CTQ	1,844,649	Japan
49	Mix	HP	XW1IC (E21EIC, op)	1,007,288	Laos
49	Ph	LP	HSØZHC	280,841	Thailand
49	CW	HP	HSØZKX	743,225	Thailand
49	CW	LP	E21YDP	77,691	Thailand
51	Ph	LP	YB9WAN	12,198	Indonesia
55	Ph	HP	VK4TS	231,564	Australia
56	CW	LP	3D2KM (W6ZL, op)	35,868	Fiji
57	Mix	LP	ZS2NF	56,316	South Africa
57	Ph	LP	ZS1BHJ	15,750	South Africa
58	Mix	HP	VK6SMK	14,196	Australia
58	Ph	LP	VK6RC	7,920	Australia
59	CW	HP	VK2DX	1,352,370	Australia
59	CW	LP	VK2GR	221,622	Australia
69	CW	HP	RI1ANT (RW1AI, op)	110,763	Antarctica

Full Results are a Click Away

You can find the complete writeup of the 2014 IARU HF Championship contest online at **www.arrl.org/contest-results**. You'll find more in-depth analysis, photos, and individual soapbox entries to enjoy.

Bernie McClenny, W3UR, w3ur@arrl.org

Upcoming DX This Year and Next

Of the nine entities that haven't been QRV in a decade, operations from several are on the horizon.

I just finished editing the annual DXCC Year End Review that Joe Reisert, W1JR, does for *The Daily DX* and *The Weekly DX* newsletters. In his overview, he notes that there were 286 DXCC Entities QRV in 2014, which is the same number as the year before. Looking at the 2013 *DX Magazine*'s Most Wanted list, three countries out of the top 10 were QRV during 2014 — FT4TA on Tromelin, FT5ZM on Amsterdam Island, and ZS8A, C, and Z on Marion Island. Not a bad year!

Another bit of DX trivia I noticed was the list of countries that had not been QRV in the last 10 years. There are nine of them: BV9P — Pratas Island; CEØX — San Felix and San Ambrosio; KH1 — Baker and Howland Islands; KH3 — Johnston Island; KH5K — Kingman Reef; KP1 — Navassa Island; P5 — North Korea; VKØ/H — Heard Island, and one other mysterious entity. Back in the December 2014 "How's DX?" column, I mentioned there was a DXCC entity that had not been QRV for more than 12 years, but I was unable to give any details, as I was sworn to secrecy. I can now tell you it was VP8/Sa — South Sandwich. More details on that in a minute.

Of the nine countries that have not been QRV in the last 10 years, as of this writing, operations from several are on the horizon. And, if all went well, K1N from Navassa Island (KP1) should be in our rear-view mirror by now, as it was expected to take place in late January and early February of this year. There should be no excuses if you missed that one, as there was plenty of notice in all the DX outlets.

Looking to the future for the remaining eight DXCC entities, local BV ops in Taiwan are talking about BV9P. Getting to San Felix seems to be at a standstill, however, it seems it is possible to go to San Ambrosio, the other half of the CEØX DXCC entity. It's been very quiet in the American Pacific. The US Fish and Wildlife Service (USFWS) seems to have reservations about allowing operations, but perhaps after the somewhat recent very successful operations from Desecheo, Midway, and Kure Island (and hopefully likewise with the Navassa Island DXpedition), they will soften up with places like Baker/Howland and Johnston Island. It seems they already are, along with The Nature Conservancy for Palmyra. At least one group is looking at KH3. Kingman may be a bit more difficult, as there seem to be some safety concerns. VKØ — Heard Island is now on the DX calendar as Dr Bob Schmieder, KK6EK, announced the expedition will take place between November 22 and December 8 of this year. As for P5, I know of at least four groups or individuals looking at going, several of which have publicly said they are attempting to go there. Unless there are some major political changes, I have a hard time seeing this one happen this year (but I would like to eat those words).

Solar Cycle 24 Update from Frank Donovan, W3LPL

Many solar cycles are double-peaked, but this is the first recorded sunspot cycle during which the second peak is larger than the first peak (from 3 years ago), largely a result of the largest sunspot group (AR12192) of Solar Cycle 24 (see Figure 1 for more solar cycle data). The current solar cycle is the weakest since Solar Cycle 14, which had a maximum of 64.2 in February 1906, and the third in a trend of weakening sunspot cycles following the end of a 50- to 60-year period of unusually large solar cycles during the second half of the 20th century, as shown in Figure 2. While many solar scientists believe that Solar Cycle 25 — peaking around 2025 — is likely to be the weakest in centuries, more accurate estimates of its amplitude will not be possible until 2 to 3 years prior to solar minimum, around 2020. Sunspot cycles could virtually disappear during much of the 21st century if we're entering

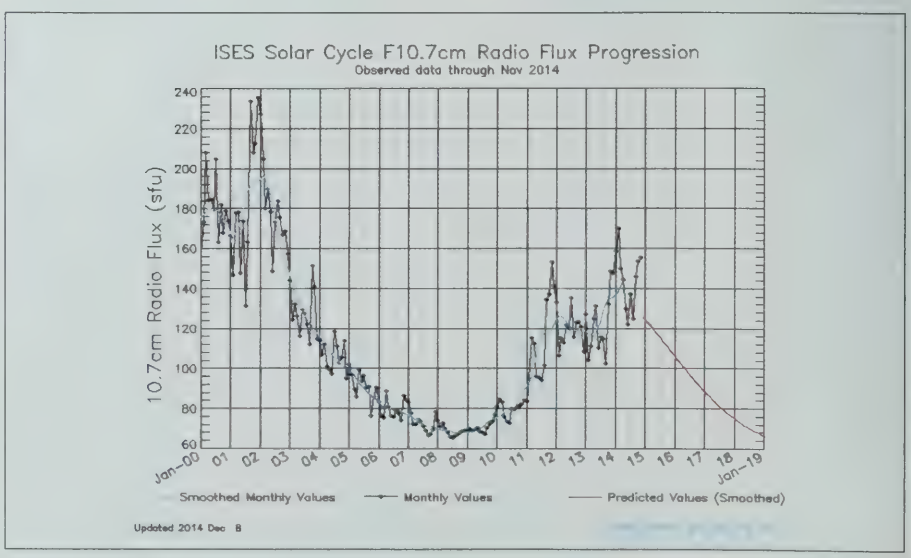


Figure 1 — Solar Cycle 24 was the first cycle recorded that had a double peak (the first in 2011 and the second in 2014) where the second peak was higher than the first.

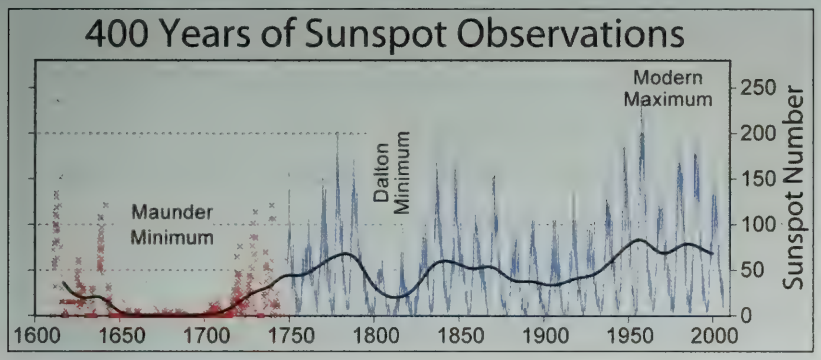


Figure 2 — This graph details the last 400 years of direct sunspot measurements using solid observational data since 1750. Less accurate numbers from the Maunder and Dalton minima are also included. This sunspot graph is from Robert A. Rohde, *Global Warming Art* at **upload.wikimedia.org/wikipedia/commons/2/28/Sunspot_Numbers.png**.

a prolonged solar minimum similar to the Maunder and Dalton minimums, during which relatively few sunspots were formed.

VP8 — South Georgia and South Sandwich

Now for the news of South Sandwich. This one is actually going to be a two-fer as Paul Ewing, N6PSE, and David Collingham, K3LP, have announced they will be lead members of the multi-national Intrepid-DX Group to both South Sandwich Island and the South Georgia Islands in January of next year. This trip involves 14 operators, including: Bill Beyer, N2WB; Arnie Shatz, N6HC (Team Physician); Dima Zhikharev, RA9USU; Jun Tanaka, JH4RHF; Krassy Petkov, K1LZ; David Jorgensen, WD5COV; Al Hernandez, K3VN; Craig Thompson, K9CT; Jay Slough, K4ZLE; Kevin Rowett, K6TD; Steve Wright, VE7CT, and Mark Stennett, NA6M. As of press time, they are planning approximately 8-day operations from both locations, "weather and sea conditions permitting." Their primary goal will be to give as many people as possible an all-time new one, with a secondary emphasis on the low bands.

For more details on the expected upcoming early 2016 DXpedition to South Georgia and South Sandwich, keep an eye on their website at **www.intrepid-dx.com/vp8** and your favorite DX outlet.

DX News From Around the Globe

5Z — Kenya

Bertrand, DF3FS, and Oli, DL9OLI, have announced plans to be QRV as 5Z4/DF3FS on CW and 5Z4/DL9OLI on SSB, respectively, from February 16 to March 8. They will be using verticals on 80 – 30 meters and Hexbeams on 20 – 10 meters. QSL via DF3FS, either direct or via the bureau. They have a website at **www.df3fs.de/5z-2015/index.html**.

7Q — Malawi

Two teams are planning to operate 7QAA from the Ngala Lodge (grid locator KH77ap) on the shore of Lake Malawi between March 11 and April 1. The first group will do CW and RTTY only on 1.8 through 28 MHz between March 11 and 21. Those ops include Neil, VA7DX; Roger, ZS6RJ; Keith, VE7KW; Emil, DL8JJ; Don, VE7DS; John, GW4SKA; Axel, DL6KVA, and possibly Dick, N7RO. Team two will do SSB and RTTY only from March 22nd to April 1st. Those team members are Frosty, K5LBU; Sam, ZS6BRZ; Dick, K9APW; John, GW4SKA; Chris, G8APB; Marco, HB9OCR, and two more ops whose slots have yet to be filled. They will be uploading their logs to Club Log daily and to Logbook of The World (LoTW) after the DXpedition. View their website at **www.malawidx.org/index.html**.

9Q — Democratic Republic of Congo

The Italian DX Team (IDXT) is teaming up with the Radioamateur Association of the Democratic Republic of Congo (ARAC) to activate 9QØHQ club station in Kinshasa for a "short stay" in March. The exact dates were not mentioned at press time. While there, the IDXT will help the club with "theoretical and practical training and refresher courses" for the local ops. Plans are for activity on 1.8 through 50 MHz on CW, SSB, and RTTY. Keep an eye on the IDXT website at **www.i2ysb.com/idt**. The team will include I2YSB, IK2CIO, IK2CKR, IK2DIA, IK2HKT, JA3USA (for 1 week only), and I1HJT. The pilot stations are IK7JWY for HF and IKØFTA for 50 MHz.

CEØZ — Juan Fernandez Islands

Members of the Provins ARC (F6KOP) have announced they will be doing a DXpedition to Robinson Crusoe Island (SA-005) starting on February 20. Team leader Alain, F5JTV, along with co-leaders Tony, F8ATS, and Jean-Luc, F1ULQ, will lead a multi-national group for activity on 160 through 6 meters until March 8.

E3 — Eritrea

Zorro, JH1AJT, is planning a multi-national team DXpedition to Eritrea sometime in March. Keep an eye on your favorite DX newsletter for up-to-date details on this one.

H44 — Solomon Islands

It's back to central Honiara for Bernhard, DL2GAC, who will again be QRV as H44MS until April 30. He's got a K3 and Ameritron ALS500 amplifier and will be active on 80 – 6 meters on SSB only. Bernhard is hoping to wrap up his 5-Band WAS by working Kansas on 40 meters for his 250th state. Listen for him daily, especially on 80 and 40 meters. QSL via DL2GAC.

P2 — Papua New Guinea

Norbert, DH1NK, is now working at a hospital in Finschhafen, Morobe Province until mid-June. He has IC-7000 and IC-706MKII transceivers with 100 W and a Windom for six bands (80, 40, 20, 17, 12, and 10 meters) and is operating on SSB and PACTOR as P29NK. QSL via DH1NK, preferably via the DARC QSL Bureau.

ZD8 — Ascension Island

A team of German ops is heading here to activate ZD8D between February 2 and March 6. Listen for DJ9KH, DK9BDN, and DL6KAC who will be using a K3 transceiver along with verticals, a Moxon, and a 6 meter Yagi, with an emphasis on 1.8 through 7 MHz. They plan to have a Beverage for receiving. They will be QRV on 1.8 – 50 MHz, including 5 MHz, on CW, RTTY, and SSB. QSL via DL9HO.

Wrap Up

That's it for this month, with thanks to N6PSE, W3LPL, and *The Daily DX* for helping to make this month's column possible. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, NØJK, n0jk@arrl.org

The Little 432 MHz EME Station That Could

Modern technologies bring the Moon down to Earth for small stations.

With advances in software and hardware technology, EME (Earth-Moon-Earth) communication is now possible for modest stations on the 70 centimeter (cm) band. Back when the high-orbiting Amateur Radio satellites such as AO-10 and AO-13 were operational, a typical satellite station might run 100 – 200 W driving one or two Yagis on the 70 cm uplink. Now a similar station can use the Earth's largest satellite — the Moon — as a reflector to make contacts. Paul Bock, K4MSG, sends this account of his 432 MHz EME contact:

> Once again, my "Little 432 EME Station That Could" (see Figure 1) came through and delivered my fifth continent toward a 432 MHz Worked All Continents (WAC) award! This morning just after 6 AM EST, I completed a two-way EME contact with VK4EME in Australia. Many thanks to Allan for alerting me that he was again active on 432 MHz EME. Also many thanks to TE Systems for the 4450G amplifier/preamp, which has performed flawlessly since the summer of 2013 on both 432 EME and 432 tropo, sometimes (especially on EME) running on-off-on-off with no pauses for several hours as I called CQ continuously, so the 'big guns' could find me with their software defined radios. It's also seen some heavy use lately on tropo CW as I try to bag some of the western grids out to 400 miles. This leaves only Africa to round out my WAC on 432.

70 Centimeter Digital TV DX Record

In the fall of 2011, Jim Andrews, KH6HTV, reported a digital TV (DTV) record for Colorado. At that time, he made a 75-mile, one-way DTV contact from Cheyenne, Wyoming to Boulder, Colorado on 70 cm using CATV 64-QAM (quadrature amplitude modulation). The secret to their success was the use of Bill's, KØRZ, giant moonbounce antenna (27 dBi).

Recently, the hams in Boulder have begun experimenting with the European DTV standard, DVB-T (Digital Video Broadcasting — Terrestrial). We have found that it is far superior for over the air transmissions compared to CATV 64-QAM, both in terms of receiver sensitivity and also tolerance for multipath propagation effects. We decided to repeat the 2011 DTV DX test, but this time using ordinary, conventional Yagi antennas.

On October 28, Don, NØYE; Jack, KØHEH; Roger, KØIHX, and Jim, KH6HTV, accomplished making a one-way, high-definition, 1080P, DVB-T contact over a 77-mile path from Cheyenne (DN71nb) to Don's shack (DN79ix) in Boulder. The contact was on 429 MHz with a 6 MHz bandwidth. Figure 2 is the live image displayed on Don's, NØYE, TV screen, which documents the success.

The transmitter was the HiDes model HV-100EH distribution amplifier (**www.hides.com.tw**) and DVB-T modulator driving a KH6HTV Video model 70-9A 25 W linear RF amplifier. The DTV output power was 10 W. The transmit antenna was a six-element Yagi. For receiving, NØYE used a HiDes model HV-110, DVB-T receiver and a 12-element Yagi antenna.

Figure 1 — Paul, K4MSG (FM19ee), uses this 2 × 18 H-mounted LFA Yagis and 170 W for his 432 MHz EME contacts. [Paul Bock, K4MSG, photo]

Antennas for 70 Centimeters

The Yagi is a practical antenna for the 70 centimeter band. An easy and inexpensive Yagi to build on 70 cm is the Quagi, which is a hybrid of the quad antenna and the Yagi — with quad-style (square-shaped loop) driven and reflector elements (see Figure 3). Wayne Overbeck, N6NB, developed an eight-element design back in 1972. Wayne set up a home antenna range and tediously designed and optimized the antenna one element at a time. He published his results in the April 1977 issue of *QST*.[1]

[1]Notes appear on page 98.

Figure 2 — Jim, KH6HTV, set a DTV record with this 77-mile 33 centimeter transmission to Don, NØYE. [Don Nelson, NØYE, photo]

Figure 3 — This eight-element Quagi is easy to construct, reliable, and outperforms equivalent Yagi. [Jon Jones, NØJK, photo]

Wayne notes:

The original Quagi antennas used wooden booms (1 × 2 or 1 × 3 inch Douglas Fir, tapered at both ends to reduce the weight and wind load), but any other nonconductor (fiberglass, Plexiglas, or even taped bamboo) can be used. [I use PVC pipe. — *Ed.*] If an aluminum boom is used, the elements should be mounted on insulators above or below the boom (not passed through a metal boom). Many builders have used small pieces of hardwood molding to mount the directors atop an aluminum boom.

The driven element and reflector are mounted on non-conductive spreaders such as dowel rods or strips of Plexiglas to avoid interaction. The driven element has a coaxial connector (an SO-239 will work but the type-N connector is preferable at UHF) at the center of the bottom side of the element and is fed directly with 50 Ω coaxial cable. In the original design, covered solid #12 TW house wire was used for the quad-style elements. The use of other types of wire, or even removing the insulation, may change the resonant frequency enough that the length has to be adjusted.

Build the antenna to the dimensions given below and develop an SWR curve, noting the SWR above and below the desired operating frequency. If it is lowest below the desired frequency, the driven element should be made shorter. If the SWR is lowest above the desired frequency, make the driven element longer. The reflector should then be adjusted in length a similar amount. Many builders have used THHN wire, which is more readily available than type TW now. They generally report that the resonant frequency is higher than expected, which means the loop elements have to be lengthened slightly for THHN wire. Tests in 2003 indicated that each wire loop should be about 1% longer than the original dimension if THHN wire is used.

Fine-tuning of the element length is usually not needed for the directors, provided they are made of ⅛-inch aluminum rods, brass welding rods, or something similar, and the boom is a nonconductor or the elements are mounted on insulators above or below the boom. If the elements pass through a metal boom (even with insulating sleeves), the length will have to be adjusted experimentally (have fun!). The director lengths are tapered from longest (closest to the driven element) to shortest (at the front of the antenna).

Although the quad loops are square or circular, the antenna is linear in polarization, not circular. If the driven element loop is fed at the bottom, the antenna will radiate horizontally-polarized RF. If the driven loop is fed on either side, vertical polarization will result (in which case the directors must be mounted vertically, not horizontally).

Some builders have tried baluns to correct the imbalance in this quad-style feed arrangement. In many cases, a balun introduces losses so great that it's better to live with the unbalanced feed than to try to correct it. Feed line radiation can be reduced by placing toroids on the feed line at the antenna. Also, the feed line should run away from the feed point along the boom or below it and then down the supporting mast, perpendicular to the elements to avoid interaction problems. If well-built, the eight-element Quagi usually comes in at 12 dBd forward gain.

Here are the dimensions (in inches) for the 432 MHz eight-element Quagi:

Reflector (R) 28, Driven Element (DE) 26⅝, the six directors (D1 – D6) range from 11¾ to 11⁷⁄₁₆ in ⅛ steps.

Spacing: R – DE, 7; DE – D1, 5¼; D1 – D2, 11; D2 – D3, 5.85; D3 – D4, 8.73; D4 – D5, 8.73, and D5 – D6, 8.73

With a single eight-element Quagi and 10 W on 70 cm, I can work the Chicago, Illinois area from northeast Kansas during the summer months on tropo. For more gain, Wayne has designed a 15-element long boom version. There is also the W5UN 11-element Quagi. John Lock, KFØM, converted W5UN's 144 MHz design for 432 MHz. It has 13.56 dBd gain on an 8-foot boom. More information about Quagis can be found in the *ARRL® Antenna Book*, or at **n6nb.com/quagi.htm** or **www.w5un.net/w5unqu97.htm**.[2]

On the Bands

50 MHz. E_s-TEP openings to New Zealand and 2 days of F2 openings were the noteworthy 6 meter events for stations in North America. On December 5, Joel, KG6DX (QK23), in Guam, worked SV1DH and I6BQI beaming 325° at 0900Z. This was the first time in Cycle 24.

Dan, KF6A, reports that on December 14

> around 2300Z, Bob, ZL1RS, was in to Michigan with a decent signal on 6. Propagation indicators were present toward Bob. K5SIX/B, NØLL/B, and WBØRMO/B were all in with NØLL/B the strongest at S9+. Texas beacons were also in.

Russ, K4QI (FM06), also worked ZL1RS at 2330Z. Russ says, "I worked him with 559 reports both ways for DXCC # 136. This is my first new one since HKØNA. ZL1RS was into FM06 for over an hour solid with peaks at 579. Nothing else was heard."

F2 appeared on the mornings of the 21st and 22nd. This was mostly single-hop F2 from North America to northern South America and the Caribbean, with some to Africa and Europe for East Coast stations, which is associated with periods of geomagnetic storming. Lefty, K1TOL, in Maine, notes

> I turned on the radio at 8:30 AM and heard CW on 50.035. I turned the beam and finally copied CS5BALG/B at S7-9. Surprise. I did not hear any VO1 beacons. I ended up working four Portugal stations before 9 AM or so. I heard the other CS beacons and the ED7 beacon also. Then I worked a few Fs and a few EIs. At the end, I worked an OE9, a G7, heard a few weak DLs, heard GMØ and MDØ, and was heard in PA and SM (but no contacts there).
>
> At the same time, over a 3-hour period, I was hearing the SA beacons and stations, and Caribbean stations, but I was still beaming to Europe. All finally ended by noon local time.

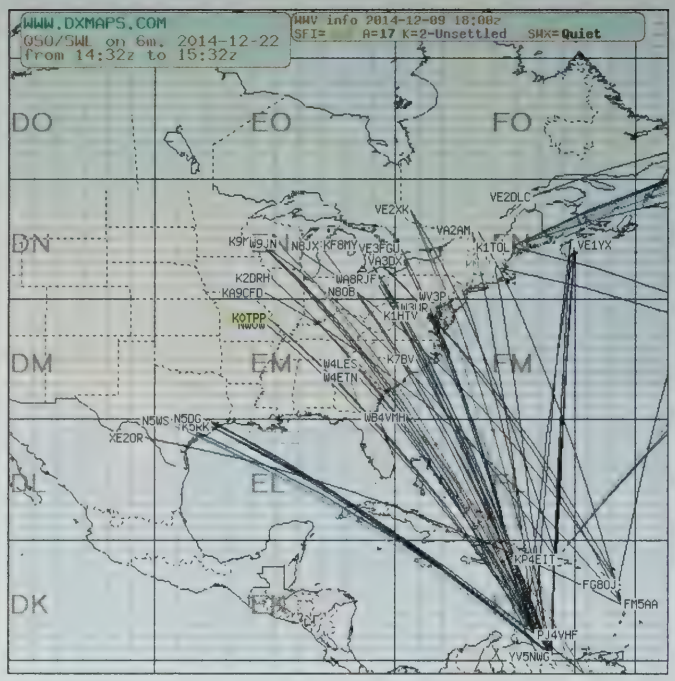


Figure 4 — A sporadic E event occurred on December 22, connecting the Eastern Seaboard with the Caribbean and South America. [**dxmaps.com**]

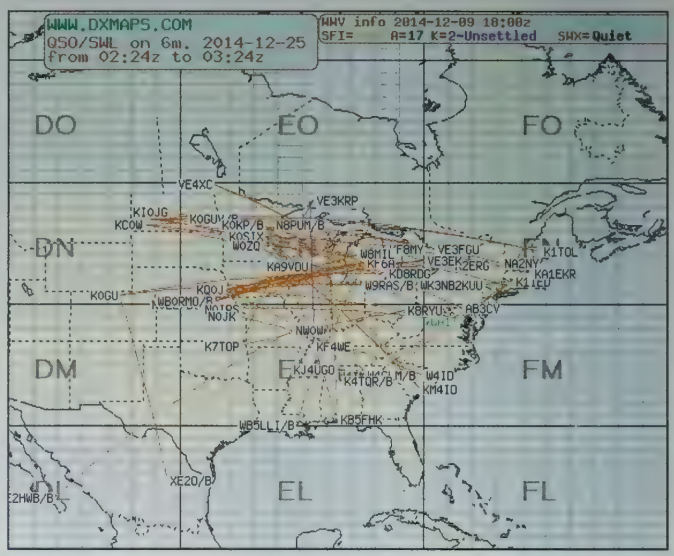


Figure 5 — A Christmas episode of sporadic E brought many in the Midwest the gift of DX. [**dxmaps.com**]

From Kansas, Larry, NØLL (EM09), worked NP4BM (FK68) via F2 at 1512Z while running only 80 W. Rich, K1HTV, worked EI4DQ, EI3KD, and CU1EZ around 1540Z.

The F2 repeated on the 22nd (see Figure 4). Sam, WA3IUH (FN20), logged YV5IUA with "10 over S-9" signals at 1437Z using a four-element Yagi. Bob, W4ETN (EM83), worked FM5AA, YV5IUV, YV6DFF (FJ78), and YV5NWG with loud signals at 1430Z. From Bonaire, PJ4VHF worked stations from the East Coast west to Texas at the same time. Later, Dave worked N7NW (CN87) in the Pacific Northwest at 1712Z. This contact is longer than a single F2 hop — perhaps chordal F2? K1HTV logged ON4IQ along with YV5IUA, YV5EAH, and YV6DFF. Rich says some northeast states and VE2 worked C5YK between 1500 – 1545Z. These could be the last 6 meter F-layer contacts from North America to Africa and Europe of Solar Cycle 24.

The winter E_s season peaked in December. Strong single-hop E_s from KS to W1, W2, W4, and VE2 were noted by NØJK and NØXA (EM28) on the 19th around 1600Z. On Christmas Eve (25th UTC), Chuck, NA6XX (CM97), worked ZL3RC at 0113Z. Joel, KQØJ (EN11), logged K8RYU (EM99), K2ERG (FN12), KF6A (EN73), and WK3N (EN91) at 0300Z. W4ID (FM04) was loud via E_s to NØJK at 0320Z (see Figure 5).

144 MHz. A strong tropospheric opening to KY, TN, and GA was noted by Dan, KF6A (EN73), in Michigan, on the 13th around 1330Z. Fred, KH7Y, worked ON4AOI on EME the 6th.

222 MHz. Jay, NY2NY, says his best contact on 222 MHz meteor scatter during the Geminid shower was with "Lyle, NØLWF, in EN10 — Nebraska — from FN30 in NY at 1234 miles on December 14 at 1515Z! A new state and grid for both of us!"

902 MHz. Vic, WB4SLM (EM72), worked Corey, N4NGZ (EL98do), in Florida on 902.1 with 41 to 51 signals on December 27. He says "Corey runs homebrew transverters on the bands, a homebrew antenna, and only 4 W on 902 MHz for the 303 mile contact."

1296 MHz. Vic, WB4SLM, "had a weak SSB contact 41 to 51 with N4NGZ. Corey's power on 23 cm was 1 W and a short loop Yagi — 23 cm 1 W on his end! ... First time I've got him in the log after several tries over the months..." Vic "also worked Ken, N4TUT (EL98gp), and Terry, N4TWX (EL89tw), with good 55 to 59 signals on the 27th." In the EME contest on the 6th, Steve, N4PZ, made 23 contacts all on CW. Steve runs 1500 W and a 16-foot dish antenna.

Here and There

Richard, NØRW, has a question regarding grid squares: "If I take my boat into the Gulf of Mexico and anchor on a corner of four grid squares, can I 'give' a contact for all four at once? I have been thinking of doing this to offer rare grids to folks on 6 meters and above."

The ARRL VUCC rules (**www.arrl.org/vucc**) note:

(e) Stations who claim to operate from more than one grid locator simultaneously (ie, from the boundary between two grid locators or from the intersection of four grid locators) must be physically present in all locators to give multiple locator credit with a single contact.

(f) Grid boundary lines and grid corners must be established using a GPS receiver whose map datum is set to WGS84, the global default for current GPS receivers.

Notes

[1]W. Overbeck, N6NB, "The VHF Quagi," *QST*, Apr 1977, pp 11 – 14.

[2]Available from your ARRL dealer, or from the ARRL Store, ARRL order no. 6801. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop**; **pubsales@arrl.org**.

Special Event Stations

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Through Dec 31, 0001Z – 2359Z, K6BB, Big Bear Lake, CA. Big Bear Amateur Radio Club. **40th Anniversary Year**. 28.440 21.340 14.340 7.240. QSL. BBARC, PO Box 790, Big Bear Lake, CA 92315. *This year-long event will be on the air at various times throughout 2015. The actual anniversary is in September.* **www.bbarc.org**

Feb 1 – Feb 28, 0000Z – 0000Z, KB9GSY, Hammond, IN. Arab QRZ Club. **JY1 Memorial**. 28.500 21.300 14.0252 7.190. QSL. Ayman Azar, 4421 Clark Ave, Hammond, IN 46327. *All bands 160 through 2 meters, all modes.* **kb9gsy@hotmail.com** *or* **www.arabqrz.com/site/jy1.htm**

Feb 14, 1500Z – 2100Z, K8BF/FYAO, Kent, OH. Portage County Amateur Radio Service. **Freeze Your Acorns Off — FYAO**. 14.250. Certificate. Bob Hewett, K8FEY, 3670 Sea Ray Cove, Aurora, OH 44202. *CW and SSB in the General portion of the 6, 10, 15, 20, 40, and 80 meter bands. Power limit for /FYAO stations is QRP. Participating stations will use their own call sign/FYAO or call CQ FYAO. Only stations at the Freeze Your Acorns Off event site should use the /FYAO designator.* **www.portcars.org**

Feb 21 – Feb 22, 1830Z – 1830Z, W4P, West Palm Beach, FL. Wellington Radio Club. **Protect the Panther**. 21.260 14.260 7.160 Echolink via WB2NBU. QSL. Georg Samulkewitsch, K4WRC, 12190 Broadleaf Ct, West Palm Beach, FL 33414. *30th anniversary of the first confirmed sighting of the endangered Florida Panther at the Corbett Wildlife Management Area.* **qsl.net/k4wrc**

Mar 1 – Mar 31, 0000Z – 2359Z, N2XJ, New Providence, NJ. New Providence Amateur Radio Club. **50th Anniversary**. 28.365 21.365 14.265 7.265. QSL. NPARC, PO Box 813, New Providence, NJ 07974. *May also operate CW and digital modes.* **www.nparc.org**

Mar 6 – Mar 8, 0808Z – 0812Z, AA5KC, Brackettville, TX. Las Moras Amateur Radio Club. **Fort Clark Springs Festival**. 28.400 21.300 14.200 7.200. Certificate. Las Moras Amateur Radio Club, PO Box 122, Brackettville, TX 78832. *Commemorating Old Fort Clark, a US Army Fort built to protect the stage route between San Antonio to El Paso, TX.*

Mar 7, 1700Z – 2100Z, W1BSA, Fall River, MA. Massasoit Amateur Radio Association. **W1BSA from the USS *Massachusetts***. 14.259 7.259. Certificate & QSL. Rick Emord, KB1TEE, 135 Wareham St, Middleboro, MA 02346. *Scouts will be on the ship overnight.*

Mar 8, 1400Z – 2300Z, WM3PEN, Philadelphia, PA. Holmesburg Amateur Radio Club. **Pennsylvania Charter Day**. 14.260. QSL. Holmesburg ARC, 3341 Sheffield Ave, Philadelphia, PA 19136. **www.qrz.com/db/wm3pen**

Mar 13 – Mar 16, 0000Z – 2359Z, N6E, Healdsburg, CA. Will Pattullo. **100th Anniversary of the Panama Pacific International Exhibition, 1915, San Francisco**. 28.450 21.265 14.265 7.265 . QSL. Will Pattullo, 161 Presidential Cir, Healdsburg, CA 95448. **www.qrz.com/db/ae6yb** *or* **ae6yb.jigsy.com**

Mar 14, 0001Z – 2359Z, N8P, Marquette, MI. Lake Effect Amateur Radio Club. **World Wide Pi Day/Einstein's Birthday**. 28.450 14.070 7.180 7.083 (Hell). QSL. Lake Effect ARC/Pi, 36 Southfork St, Marquette, MI 49855. **qsl.net/kd8dku**

Mar 14, 1600Z – 2000Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. **WE7GV Celebrates 100 Years of *QST* Magazine**. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. **gvarc.us**

Mar 14, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* Museum Ship. **Launching of USS *Midway* (CV-41) Celebration Special Event**. 14.320 7.250; PSK31 on 14.070; D-STAR REF 1c. QSL. USS *Midway* Museum Ship Radio Room, 910 N Harbor Dr, San Diego, CA 92101.

Mar 14 – Mar 15, 1300Z – 1900Z, N4G, Greensboro, NC. Greensboro Amateur Radio Association. **234th Anniversary of the Battle of Guilford Courthouse**. 21.324 14.324 7.234 3.900. QSL. N4G – GARA, PO Box 7054, Greensboro, NC 27417. *Frequencies +/– QRM. Watch for spots on DXSUMMIT.* **www.n4g-gch.org**

Mar 20 – Mar 22, 1500Z – 2200Z, K5NRH, North Richland Hills, TX. North Richland Hills Amateur Radio Club. **Ten Year Anniversary**. 28.445 21.330 14.270 7.200. QSL. K5NRH 10 Year Anniversary, PO Box 821426, North Richland Hills, TX 76180. *Club members will be operating from their home QTH on SSB and PSK31.* **nrharc.org**

Mar 21, 1400Z – 2000Z, W4BKM, Macon, GA. Macon Amateur Radio Club. **33rd Annual Cherry Blossom Festival**. 14.240 7.225 145.37. Certificate. MARC, PO Box 4862, Macon, GA 31208. **w4bkm.com/home**

Mar 22, 0900Z – 1700Z, OT70BULGE, Houmont Belgian Ardennes, Belgium. VERON. **Remembering The Battle of the Bulge**. SSB and CW, 10, 20, 40, and 80 meters. QSL. Joe Somers, PAØSOM, Prinsenlaan 59, Maasmechelen Belgium 3630, Belgium. **pa0som@veron.nl**

Mar 24 – Mar 26, 1400Z – 2100Z, W4LX, Fort Myers, FL. Fort Myers Amateur Radio Club. **Honoring World War II Gunners at Buckingham Airfield**. 28.360 21.360 14.270 147.345. Certificate. W4LX, PO Box 61183, Fort Myers, FL 33906. **www.fmarc.net**

Mar 28, 1400Z – 2100Z, N4H, Alexander City, AL. Lake Martin Amateur Radio Club. **Battle of Horseshoe Bend (Creek Indian War) Anniversary**. 14.325 7.280. Certificate & QSL. John Philips, WI4P, PO Box 938, Alexander City, AL 35011. **wi4p@arrl.net**

Mar 28, 1400Z – 2130Z, KK5W, Rosenberg, TX. Brazos Valley Amateur Radio Club. **14th Annual Greater Houston Hamfest**. 21.250 14.250 7.250; 146.94 (-) PL 167.9Hz. QSL. Brazos Valley Amateur Radio Club, PO Box 2997, Sugar Land, TX 77487. **www.houstonhamfest.org**

Mar 28 – Mar 29, 1400Z – 2200Z, W4P, Punta Gorda, FL. Peace River Radio Association. **35th Annual Florida International Air Show**. 28.435 21.335 14.235 7.235. QSL. Peace River Radio Association, PO Box 510943, Punta Gorda, FL 33951. **www.w4dux.net**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**. A plain text version of the form is available at that site. You may also request a copy by mail or e-mail. Offline completed forms can be mailed, faxed (Attn: Special Events), or e-mailed.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **May** *QST* would have to be received by **Mar 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

Special Events listed in this issue include current events received through January 8. You can view all received Special Events at **www.arrl.org/special-event-stations**.

March 2015 W1AW Qualifying Runs

Earn your Code Proficiency certificate or endorsements by listening to W1AW Qualifying Runs. Legibly copy at least one minute of text by hand and mail the sheet to:

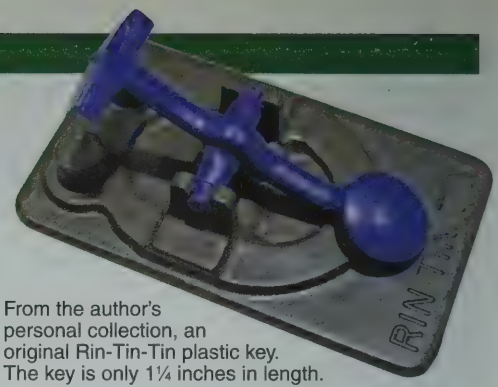
W1AW Qualifying Run, 225 Main St, Newington, CT USA 06111

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your text will be checked against the actual transmissions to determine if you have qualified.

March Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 10 PM EST on Friday, March 6 (0300 UTC March 7) and at 7 PM EDST on Wednesday, March 18 (2300 UTC) at 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6KPH on Saturday, March 14, at 2 PM PDST (2100 UTC) at 3581.5, 7047.5, 14047.5, 18097.5, and 21067.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Toy Telegraph Keys

They were toys indeed, but they started many a child on the road to Amateur Radio.



From the author's personal collection, an original Rin-Tin-Tin plastic key. The key is only 1¼ inches in length.

Harold Kramer, WJ1B
ARRL Chief Operating Officer
wj1b@arrl.org

Click, click; flash, flash; buzz, buzz! Toy telegraph keys were educational, fun, and popular with kids for decades. Thanks to toy telegraph keys, kids mastered Morse code, learned about electricity, and assembled simple two-way communications systems. These skills prepared young people of that time for careers in electronics. Many obtained their Amateur Radio licenses.

Commercial telegraph key manufacturers, such as Signal Electric, and toy manufacturers, such as AC Gilbert of Erector Set fame, manufactured toy keys. Of course, these were not practice or training keys. True training keys are higher quality and more functional. However, the line between these devices is sometimes blurred.

Figure 2 — A Fleron Signaler Boy Scout key and its colorful box. This strap key has a buzzer and signal light. It also has a Morse code chart permanently molded into its base.

Marketing to Curious Kids

Toy keys were packaged in colorful boxes as complete "outfits" or "sets" that let young operators "learn the Morse code" and "send secret messages to their friends." These sets were marketed as two-way communications systems and included two telegraph keys with terminals for external connections; the wire to interconnect them; a mode switch; batteries, and transducers to change the electricity into light, clicks, or buzzes. Many sets included nicely illustrated instructional booklets and Morse code charts (see Figure 1).

Any telegraph key is a single pole, single throw (SPST) switch designed for multiple make-and-break operations. So what exactly is a toy key? A toy key performs the same function, but not quite as well as a commercial key. Most toy keys use a keying lever made from a thin strip of metal that flexes up and down. This type of key is called a *strap key*. To send CW, the operator pushes the lever up and down while holding a knob at the end of the strap. There are no pivot mounts or bearings to hold the lever in a fixed position, so the lever tends to wobble both vertically and horizontally while sending. It's a difficult way to send CW. An example of a popular strap key is the Fleron Signaler Boy Scout Practice Telegraph Key (Figure 2). The Codemaster sold individually for $1.95 in the 1950s and '60s. This key was used by many Scouts to pass the Morse code requirement to become a First Class Scout.

Figure 1 — A Brumberger Official Codemaster Telegraph Signal Set contained two keys and a Morse code record.

Buzz Code

Toy keys usually buzzed when the lever was pushed. There were no electronic code

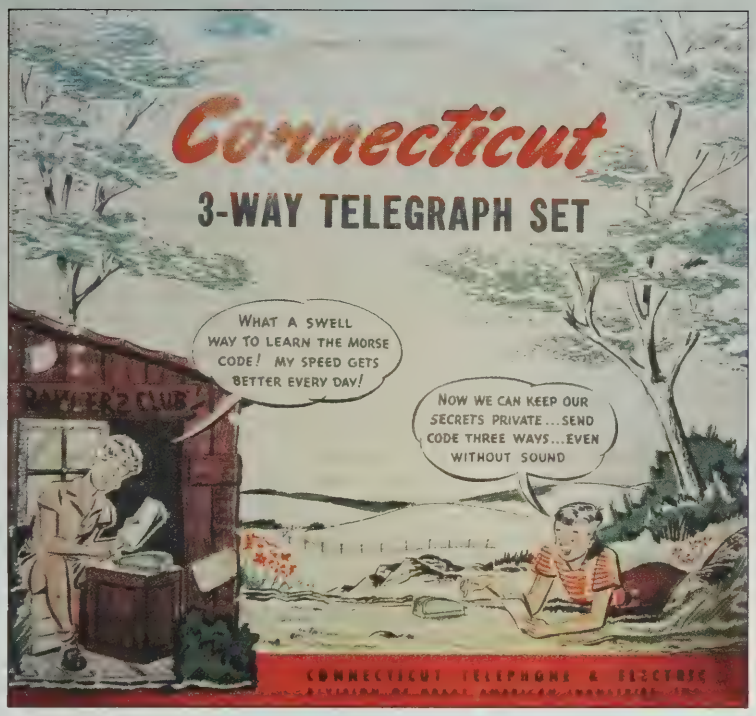

Connecticut
3-WAY TELEGRAPH SET
WHAT A SWELL WAY TO LEARN THE MORSE CODE! MY SPEED GETS BETTER EVERY DAY!
NOW WE CAN KEEP OUR SECRETS PRIVATE...SEND CODE THREE WAYS...EVEN WITHOUT SOUND
CONNECTICUT TELEPHONE & ELECTRIC

Figure 3 — From the author's personal collection: (above) one of a set of two Connecticut Telephone and Electric Company Practice keys and buzzers, and (at right) packaging for another Connecticut Telephone and Electric product.

Figure 4 — An Elkay Manufacturing Company Tri-Signal Telegraph Set. This Tri-Signal was part of a set of two keys. Note the battery case with the Morse code chart. It has steel strap key and a switch to determine the operating "mode."

practice oscillators in these inexpensive products, so a raspy electromagnetic buzzer produced the audible tone. The buzzers were hard on the ears and a fatiguing way to copy CW. Figure 3 shows a Connecticut Telephone and Electric Company Practice Key and Buzzer that was made between the 1930s and the 1950s. The buzzer is in the upper left. This toy key practice set had a metal Morse code chart riveted to the upper copper plate, a wide brass strap key, and was mounted on a wooden box that held the batteries. It was sold as a set of two.

Along with buzzers, many toy keys had small incandescent lamps that blinked when the key was tapped. These keys had switches to determine whether they buzzed, lit up, or did both. The signal lights were more acceptable options for parents who did not care to hear buzzers at all hours. The Elkay Manufacturing Company Tri-Signal Set, shown in Figure 4, has such a signal light. It was sold as a set of two keys and accessories. This device is unusual because the batteries were stored on top of the key. According to its instruction manual, it "is the latest and most improved signaling device. It is simple enough for a child and complete enough for a telegrapher."

Morse code booklets and instructions were generally included with these sets and many toy keys had Morse code charts permanently affixed on top of the key. The rationale was that a paper booklet could be lost, but if the code chart was attached to the key, it would always be available. Some of these telegraphy sets also came with vinyl records that would teach prospective telegraphers the code.

"Cereal" Code

One of my favorite toy keys is the Rin-Tin-Tin key that was based on the popular TV show of the 1950s. This tiny plastic toy key was found inside of specially marked boxes of Nabisco Shredded Wheat Cereal. Along with the blue one pictured near the beginning of this article, they also came in green, yellow, and white. This key is not operational since it has no electrical conductors. To make it work, you were supposed to place aluminum foil on the end contacts. It also came with its own unique code system!

In an era of text messaging, smartphones, and Facebook, toy telegraphs seem rather old-fashioned. But during the 60 or so years when they were popular, they fostered a lifelong interest in communications for many of us.

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Abbreviations

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

ALABAMA SECTION CONVENTION

March 7 – 8, Birmingham (Irondale), AL

D F H Q R S V

Saturday and Sunday 9 AM. *Spr:* Birmingham ARC. Zamora Temple, 3521 Ratliff Rd. *Tl:* 146.88. *Adm:* $8. **w4cue.com**.

Arizona (Scottsdale) — Mar 21 D F H R T V

5 AM – noon. *Sprs:* ARCA and Scottsdale ARC. Mountain Valley Community Church, 17800 N Perimeter Dr. *Tl:* 147.18 (162.2 Hz). *Adm:* $5. **www.scottsdalearc.org**.

Arkansas (Hoxie) — Feb 21 D F H R V

8 AM. *Spr:* Lawrence County ARC. Hoxie Service Center, 500 SW Lawrence. *Tl:* 147.045. *Adm:* $5. **www.w5wra.org**.

Arkansas (Russellville) — Mar 7 D F H R S T V

8 AM – 1 PM. *Spr:* Arkansas River Valley AR Foundation. Hughes Community Center, 1000 E Parkway. *Tl:* 146.82 (131.8 Hz). *Adm:* $5. **www.arvarf.com**.

California (Loomis) — Mar 14 D F H R T V

7:30 – 11 AM. *Spr:* Sierra Foothills ARC. Historic Loomis Train Depot Plaza, 3640 Taylor Rd. *Tl:* 145.43, 223.86 (both 162.2 Hz). *Adm:* Free. **www.w6ek.org**.

California (Palm Springs) — Mar 14 D F H R S T V

9:30 AM – 4:30 PM. *Spr:* Desert Radio Amateur Transmitting Society. Palm Springs Pavilion, 401 S Pavilion Way. *Tl:* 146.94 (107.2 Hz). *Adm:* $5. **palmspringshamfest.com**.

Colorado (Longmont) — Apr 4 D F H Q R S V

8 AM – 2 PM. *Spr:* Longmont ARC. Boulder County Fairgrounds, Exhibit Building, 9595 Nelson Rd. *Tl:* 147.27 (100 Hz). *Adm:* $5. **w0eno.org**.

Connecticut (Dayville) — Mar 14 D F H R V

8 AM – noon. *Spr:* Eastern Connecticut ARA. St Joseph's Church Hall, 350 Hartford Pike (Rte 101). *Tl:* 147.225 (156.7 Hz). *Adm:* $3. **www.ecara.net/**.

Connecticut (Southington) — Mar 15 D F H Q R S V

8 AM – noon. *Spr:* Southington ARA. Southington High School, 720 Pleasant St. *Tl:* 147.345 (77 Hz). *Adm:* $5. **www.chetbacon.com/sara.htm**.

Florida (Fort Walton Beach) — Mar 20 – 21 H Q R S V

Friday 5 – 9 PM; Saturday 8 AM – 3 PM. *Spr:* Playground ARC. C. H. "Bull" Rigdon Fairgrounds, 1958 Lewis Turner Blvd. *Tl:* 146.79 (100 Hz). *Adm:* $6. **www.w4zbb.org**.

Florida (Live Oak) — Mar 14 H R T V

8 AM – 1 PM. *Spr:* Suwannee ARC. The Farm (SARC), 9707 58th St. *Tl:* 145.41 (123.0 Hz). *Adm:* Free. **www.suwanneearc.org/smf/index.php**.

WEST CENTRAL FLORIDA SECTION TECHNICAL CONFERENCE

April 4, Sebring, FL

S

8 AM – 5 PM. *Spr:* ARRL West Central Florida Section. Bert J. Harris Agri Civic Center, 4509 George Blvd. *Tl:* 147.27 (100 Hz). *Adm:* Free. **www.arrlwcf.org**.

SOUTHERN FLORIDA SECTION CONVENTION

March 21, Stuart, FL

D F H Q R S T V

8 AM – 4 PM. *Spr:* Martin County ARA. Martin County Fairgrounds, 2616 SE Dixie Hwy (A1A). *Tl:* 147.06 (107.2 Hz). *Adm:* Free. **www.stuarthamfest.com**.

Florida (West Palm Beach) — Mar 14 D F H Q R S T V

8 AM – 2 PM. *Spr:* Palms West ARC. Fraternal Order of Police Lodge #50, 885 N 62nd Dr. *Tl:* 147.045 (110.9 Hz). *Adm:* $5. **www.palmbeachradiofest.com**.

Florida (Zephyrhills) — Mar 7 D F H R T V

8 AM – noon. *Sprs:* East Pasco ARS and Zephyrhills Area ARC. Zephyrhills Lion's Den, 5827 Dean Dairy Rd. *Tl:* 147.135 (146.2 Hz). *Adm:* $5. **www.zaarc.org**.

Georgia (Ellijay) — Mar 21 F H R S T

8 AM. *Spr:* Ellijay ARS. Ellijay Lion's Club Fairgrounds, 1729 S Main St. *Tl:* 145.17 (100 Hz). *Adm:* $5. **www.w4hhh.org/fest.php**.

Illinois (Noble) — Apr 4 D F H R T

8 AM – noon. *Spr:* WHERE ARC. Former West Richland High School, 320 E North Ave. April Fools Fest. *Tl:* 146.76 (94.8 Hz). *Adm:* $4. **www.whereradio.webs.com**.

Illinois (Sterling) — Mar 8 D F H R V

7:30 AM – 2 PM. *Spr:* Sterling-Rock Falls ARS. Challand Middle School, 1700 6th Ave. *Tl:* 146.85 (114.8 Hz). *Adm:* advance $5, door $6. **w9mep.org**.

Indiana (Brazil) — Mar 14 D F H R T

8 AM – 2 PM. *Spr:* Wabash Valley ARA. Clay County Fairgrounds, 6650 N State Rd 59. Terre Haute Hamfest. *Tl:* 146.685 (151.4 Hz). *Adm:* $6. **w9uuu.org**.

Indiana (Columbus) — Mar 28 D F H R V

8 AM – noon. *Spr:* Columbus ARC. Bartholomew County 4-H Fairgrounds, 750 W County Rd 200 S. 32nd Annual Hamfest. *Tl:* 146.79 (103.5 Hz). *Adm:* $5. **carcnet.net**.

Iowa (Perry) — Feb 28 D F H R S V

8 AM – noon. *Spr:* Hiawatha ARC. Perry National Guard Armory, 2930 Willis Ave. *Tl:* 145.19 (114.8 Hz). *Adm:* $5. **qsl.net/kd0neb/index_files/Page383.htm**.

Kentucky (Elizabethtown) — Apr 4 D F H R S T V

8 AM – 2 PM. *Spr:* Lincoln Trail ARC. Elizabethtown Community College, State Fire Training Building, 630 College Street Rd. *Tl:* 146.98. *Adm:* advance $5, door $6. **www.qsl.net/ltarc/**.

LOUISIANA STATE CONVENTION

March 20 – 21, Rayne, LA

D F H Q R S T V

Friday 5 – 8 PM, Saturday 8 AM – 3 PM. *Spr:* Acadiana ARA. Rayne Civic Center, 300 Frog Festival Dr. 55th Annual AARA Hamfest. *Tl:* 146.82 (103.5 Hz). *Adm:* advance $4, door $5. **w5ddl.org**.

MAINE STATE CONVENTION

March 27 – 28, Lewiston, ME

D H Q R S V

Friday 7 – 9 PM, Saturday 8 AM – noon. *Spr:* Androscoggin ARC. Ramada Convention Center, 490 Pleasant St. *Tl:* 146.61 (88.5 Hz). *Adm:* $7. **www.w1npp.org**.

Maryland (Frederick) — Mar 16 F T V

6 – 9 PM. *Spr:* Frederick ARC. Independent Hose Company, 310 Baughmans Ln. Indoor Tailgating Expo. *Tl:* 146.52. *Adm:* Free. **www.frederickarc.org**.

Michigan (Kalamazoo) — Mar 14 D F H Q R V

8 AM – noon. *Spr:* Southern Michigan ARS. Wings Stadium Annex, 3600 Vanrick Dr. 55th Annual Michigan Crossroads Hamfest and Radio Swap. *Tl:* 147.0 (94.8 Hz). *Adm:* $5, under 13 free. **www.w8df.com/hamfest**.

Minnesota (Buffalo) — Mar 28 D F H R V

8 AM – 1 PM. *Spr:* Maple Grove RC. Buffalo Civic Center, 1306 County Rd 134. 34th Annual Midwinter Madness Hobby Electronics Show. *Tl:* 147.0. *Adm:* $8, under 15 free. **www.k0ltc.org**.

NEBRASKA STATE CONVENTION

March 21, Lincoln, NE

D F H Q R S T V

8:30 AM – 2:30 PM. *Spr:* Lincoln ARC. Lancaster County Event Center, 4100 N 84th St. *Tl:* 146.76. *Adm:* $5 (LARC members), $8 (all others), under 16 free. **lincolnhamfest.org**.

New Hampshire (Henniker) — Mar 22 F H R S V

8 AM – 2 PM. *Spr:* Contoocook Valley RC. Henniker Community School, 51 Western Ave. *Tl:* 146.895 (100 Hz). *Adm:* $3. **www.k1bke.org**.

New Jersey (Township of Washington) — Mar 15 A D H R

Noon – 4 PM. *Spr:* Bergen ARA. Westwood Regional High School, 701 Ridgewood Rd. Annual Auction. *Tl:* 146.79 (141.3 Hz). *Adm:* Free. **bara.org**.

NORTH CAROLINA SECTION CONVENTION

March 13 – 14, Concord, NC

D F H Q R S V

Friday 3 – 7 PM; Saturday 8:30 AM – 4:30 PM. *Spr:* Mecklenburg ARS. Cabarrus Arena and Events Center, 4751 Hwy 49 N. *Tl:* 146.655. *Adm:* advance $8 (USPS), $9 (Pay Pal); door $10. **www.charlottehamfest.org**.

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

North Carolina (Kinston) — Mar 28
D F H Q R S T V
8 AM – 2 PM. *Spr:* Down East Hamfest Assn. Lenoir Community College Gymnasium, 231 Hwy 58 S. 25th Annual Down East Hamfest. *Tl:* 146.685 (82.5 Hz). *Adm:* advance $5 each or 3 for $12, door $6 each or 3 for $15.

NORTH CAROLINA STATE CONVENTION

April 4, Raleigh, NC
D F H Q R S V
8 AM – 3:30 PM. *Spr:* Raleigh ARS. NC State Fairgrounds, Jim Graham Building, 1025 Blue Ridge Rd. 43rd Annual Raleigh Hamfest. *Tl:* 146.64. *Adm:* advance $8, door $10. **www.rars.org/rarsfest**.

Ohio (Gallipolis) — Mar 28 D F H R T V
9 AM – 1 PM. *Spr:* Mid-Ohio Valley ARC. Gallipolis Christian Church, 4486 State Rte 588. *Tl:* 147.06 (74.4 Hz). *Adm:* $5. **sites.google.com/site/midohiovalleyarc/**.

Ohio (Perrysburg) — Mar 15 D H R S V
8 AM – 2 PM. *Spr:* Toledo Mobile Radio Assn. Owens Community College, 30335 Oregon Rd. Hamfest and Computer Fair. *Tl:* 147.27 (103.5 Hz). *Adm:* $7. **www.tmrahamradio.org**.

Oklahoma (Claremore) — Mar 13 – 14
D F H Q S V
Friday 4 – 9 PM, Saturday 8 AM – 3 PM. *Spr:* Green Country Hamfest Committee. Claremore Expo Center, 400 Veterans Pkwy. *Tl:* 147.09. *Adm:* advance $8, door $10. **greencountryhamfest.org**.

Tennessee (Tullahoma) — Mar 14
D F H R S T V
8 AM – 2 PM. *Spr:* Middle Tennessee ARS. First Methodist Church, 208 W Lauderdale St. *Tl:* 146.70 (114.8 Hz). *Adm:* $5, under 16 free. **www.qsl.net/mtars**.

Tennessee (Union City) — Mar 28
D F H Q R S T V
8 AM – 2 PM. *Spr:* Reelfoot ARC. Tennessee National Guard Armory, 2017 E Reelfoot Ave. Ides of March Hamfest. *Tl:* 146.7 (100 Hz). *Adm:* adults $8, under 16 $1. **www.reelfootarc.com**.

Texas (Georgetown) — Mar 14 D F H R V
8 AM – 3 PM. *Spr:* Williamson County ARC. Community Center at San Gabriel Park, 445 E Morrow St. *Tl:* 146.64 (162.2 Hz). *Adm:* $2. **www.wcarc.com**.

WEST TEXAS SECTION CONVENTION

March 14, Midland, TX
D F H Q R S T V
8 AM – 3 PM. *Spr:* Midland ARC. Midland County Horseshoe Arena, 2514 Arena Tr. 60th Annual St Patrick's Day Hamfest. *Tl:* 146.76. *Adm:* advance $8, door $9. **hamfest.w5qgg.org**.

TEXAS STATE CONVENTION

March 28, Rosenberg, TX
D F H Q R S T V
8 AM – 4 PM. *Spr:* Brazos Valley ARC. Fort Bend County Fairgrounds, 4310 Hwy 36 S. 14th Annual Greater Houston Hamfest. *Tl:* 146.94 (167.9 Hz). *Adm:* advance $8, door $10. **www.houstonhamfest.org**.

Texas (Weatherford) — Mar 21
D F H Q R S T V
7 AM – 2 PM. ARC of Parker County. Central Christian Church, Cuppett Hall, 1602 S Main St. *Tl:* 147.04 (110 Hz). *Adm:* advance $4, door $5. **w5pc.org**.

Virginia (Annandale) — Mar 22 D F H R S T
8 AM – 2 PM. *Spr:* Vienna Wireless Society. Northern Virginia Community College, 8333 Little River Turnpike. Winterfest 2015. *Tl:* 146.91. *Adm:* $7. **viennawireless.org**.

MICROHAMS DIGITAL CONFERENCE

March 21, Redmond, WA
D H R S
9 AM – 5 PM. *Spr:* MicroHAMS Radio Club. Microsoft Campus, Building 37, 15255 NE 40th St. 8th Annual Event, WiFi Connectivity. *Tl:* 146.58. *Adm:* advance $35, door $40. **www.microhams.com/mhdc.**

West Virginia (Charleston) — Mar 21
D F H Q R S V
9 AM – 2 PM. *Spr:* Charleston Hamfest Committee. Coonskin Armory, 1707 Coonskin Dr. 31st Annual Charleston Hamfest and Computer Show. *Tl:* 145.35 (91.5 Hz). *Adm:* $6.

West Virginia (Oak Hill) — Feb 21
D F H Q R V
8 AM – 2 PM. *Spr:* Plateau ARA. Lewis Community Center, 469 Central Ave. 35th Annual Hamfest. *Tl:* 147.075 (100 Hz). *Adm:* $5. **www.parawv.com**.

Wisconsin (Jefferson) — Mar 15
D H R V
8 AM – noon. *Spr:* Tri-County ARC. Jefferson County Fairgrounds, Activity Center, 503 N Jackson Ave. *Tl:* 145.49 (123 Hz). *Adm:* $5. **w9mqb.org**.

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

Events that are sanctioned by the ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in the *ARRL Letter*. In addition, events receive donated ARRL prize certificates and handouts.

For hamfests: Once the form has been submitted, your ARRL Director will decide whether to approve the date and provide ARRL sanction. *For conventions:* Approval must come from your Director and the ARRL Executive Committee.

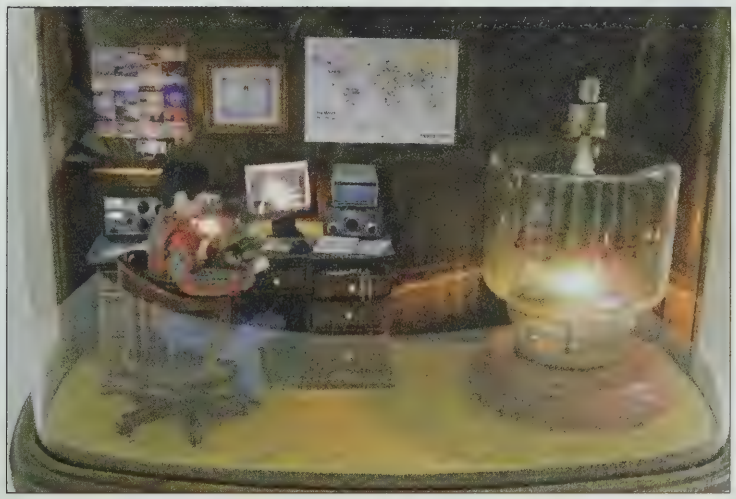
The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **March 1** to be listed in the **May** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, for driving directions, and for other event details. Please note that postal regulations prohibit mention in *QST* of games of chance such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call the ARRL Advertising Desk at 860-594-0207, or e-mail **ads@arrl.org**.

Strays

Let's Get Small

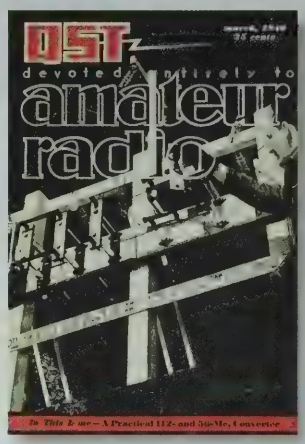
You have to be a ham of a certain age, and a fan of Steve Martin on *Saturday Night Live*, to understand the significance of "getting small." On the other hand, there is this truly tiny station crafted by Kathy Hendricks, AC4LB, and her husband Gary, K4MT. It took weeks of careful work to finish this miniature work of art.



75, 50, and 25 Years Ago

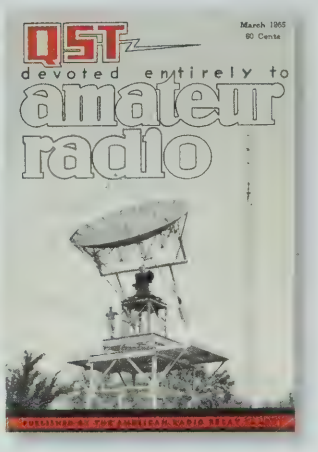
Al Brogdon, W1AB

March 1940



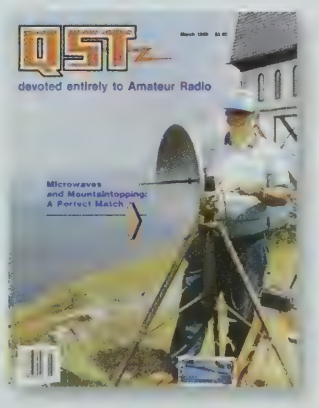
- The cover photo shows antenna switching of an array of high-gain, high-power beams used by shortwave broadcasters.
- The editorial tells of two recent "unsportsmanlike" situations involving hams.
- By Goodman, W1JPE, describes "A Practical 112 Mc. Converter."
- J. L. Hill, W9ZWW, reports on "A 'Modified' Dickert Noise Limiter."
- William Good, W8IFD, writes about his brother Walter "Winning the National Radio Control Meet," flying a radio-controlled model airplane with a 28 Mc. control link.
- In "On the Ultra Highs," Ed Tilton, W1HGDQ, gives the U.H.F. Marathon reports up to February 1.
- "The Ionosphere and Radio Transmission" (extracted from a Bureau of Standards Letter Circular), provides the latest information on ionospheric radio propagation.
- Because of the state of neutrality of the USA with regard to the European War, Ed Handy, W1BDI, gives a "12th A.R.R.L. DX Competition Warning" — any US station making contact with a European station will be disqualified.
- Walter Stiles, W8DPY, tells us how to build "A Stationary Reversible Beam."

March 1965



- The cover shows W4HHK with his 18-foot dish installation, currently set up for 432 Mc.
- The editorial suggests that hams and ham clubs should look to the CBers to recruit new amateurs, rather than turning our backs on them.
- Harley Gabrielson, W6HEK, tells us about "Oscar III Orbital Predictions and How to Use Them."
- Arthur Walters, W6DKH, discusses "Making Use of the Oscar III Telemetry Signals."
- Douglas Blakeslee, W1KLK, tutors us on "RTTY Reception for Beginners."
- In "Single-Band Combos," Elmer Schorle, W3GSC, describes his compact and lightweight transmitter/receiver units for 6 and 10 meters.
- With the current Cold War causing many Americans to build fallout shelters, George Hart, W1NJM, tells of a practical use to put those shelters to before the bombs fall, in "Hamming from Your Fallout Shelter."
- Dana Atchley, W1HKK, describes how he built "A Switchable, Four-Element 80-Meter Phased Array" that would look good in your back yard.
- John Troster, W6ISQ, always a font of information, discusses "DXMANSHIP — Phase I."
- James Rush, W4EDWL, describes his compact SWR indication for mobile use, "The Mini-Mono-Monimatch."

March 1990



- The cover photo shows K1LPS doing some microwave mountaintopping.
- The editorial discusses some current problems of "Rotten Operating" (shades of "The Old Man").
- Steve Ewald, WA4CMS, compiles reports from hams who provided emergency communication following the recent northern California "Earthquake!"
- Emil Pocock, W3EP, gives us an in-depth discussion of "Practical Radio Aurora."
- Charles Michaels, W7XOC, presents interesting information in the "Evolution of the Short Top-Loaded Vertical."
- George Thurston, W4MLE, gives us very useful tips in Part 1 of "Practical Battery-Back-Up Power for Amateur Radio Stations."
- In "A Montserrat Memoir," Jim Cain, K1TN/VP2MDC, tells us about the allure of the island that still operates the way the entire Caribbean used to.

Field Organization Reports

December 2014

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

520
W5KAV

420
KT2D

390
K7OAH

318
WM2C

258
N9WLW

270
KC5ZGG

240
KØIBS

217
WB8R

200
KE5HYW

180
W4VX
WE2G
KB2RTZ
WB8RCR

175
WD8USA

170
W5DY
N5TMC
AF7FT
N8FVM

168
WA7PTM

165
W8QAS

163
WB9FHP

161
KF4DVF

160
KGØGG
WB9QPM
WA2BSS

158
N2PQJ

157
KK7DEB

156
WS6P

152
N3KRX

150
KB1RGQ

148
W7PAT

145
K9LGU
W4DNA
WK4WC

140
K1PJS
KD5RQB
WB2FTX
WA3EZN
VE7GN
N1UMJ
KW1U
KA9QWC
KK3F

138
W8IM
KW4EMG

137
N8OSL

135
WB9WKO
KB8QKC
W8DJG
W9WXN
W3YVQ
K8RDN
WV8CH

130
WA1STU
N2JBA
K2TV
K6JT
K4IWW
NA7G

129
K3JL
W1INC
AB1ST
KM2V

125
N7EIE
KT5SR
N8SY
WB4ZIQ

120
N9VC
AG9G
NN7H
N5NVP
N2WGF
K5KV
KF5IOU
WØLAW
W9BGJ
NS7K
NM1K
KB8RCN

117
KE5YTA
KI6LNB

115
KB1WXC
KC9UJP
W9ILF
KØPTK

113
KB3KYH

112
AL7N
W9EEU

111
N2DW

110
W1KX
NX9K
KB5SDU
K2UNI
KA5AZK
KC5OZT
KF5TTN
K4GK
WAØCGZ
N1JX
KB2QO
KA4FZI
N1IQI
W2EAG
KA9FCU
N7CM
K7EAJ
N7XG
K1HEJ
W4OTN
KA1G
N9MN
WB9JSR
WS4P
WB6UZX

109
W3CB

105
KK7TN
KD8TTE
N1TF

103
W8CPG

102
NA9L

101
K9DUR

100
KØVTT
KØPTK
NØDUX
AB1AV
WA1MXT
KA2GQQ
KC8WH
WD8Q

WB8YLO
N8IBR
W8OLO
WA4BAM
KJ4JPE
WØPZD
N3SW
W4TTO
KB1NMO
AA3SB
KB3LNM
WB8WKQ
WB8TQZ
AJ4TH

97
WB8YYS
KJ4G

96
KC7ZZ

95
KCØZDA
KB5KKT
AK4RJ

93
N3RB
W8ARR

90
WBØTSR
W6KJ
KU6J
K9JM
WA6IAF
N5RL
KC2YDT
N3KB
WA2NDA
WB4BIK
WG8Z
KB8HJJ
WB8SIQ
W8WDS
WG8Z
KB8HJJ
WB8SIQ
N8CJS
W7FQQ
KF7GC
WB6OTS
KZ8Q
AF4NC
WB3FTQ
K8KV
K8ED
N4RNM
WD8DHC

89
KF7PDV
KAØDBK

88
KA2HZP

N2RTF
AB9ZA

86
W2CC
N9TU

85
KDØNJK
N8CJS
KBØDTI

84
KJ4HGH

83
WDØGUF
K7EU

82
W5XX
KD7OED

81
KA5DON

80
KØDEU
WA9QIB
AC7RB
W7JSW
WB4RJW

79
K6RAU
K4DL

78
NI2W

76
K9JAJ
WA5LOU
KC7ASA

75
KC8YVF
KA8ZGY

74
KC2EMW
K5JAW
N1LKJ

72
AJ7B
W4CPG

70
KØRXC
KDØUSN
KD7ZUP
NØDUW
NØYOL
KDØUST
WØCLS
NI0I
NR2Q
WB8QLT
KF4OCU
KM7N

The following stations qualified for PSHR in previous months but have not been recognized in this column yet: (Nov) N3KRX 249, K2TV 155, WB2ZEX 131, N2WGF 120, KC2YDT 115, KØPTK 115, WX3RHW 105, KA2EJD 85, KAØDBK 85, N2PQJ 77, AK1NS 74, K2KNB 73, N2VC 72, N2RQ 70. (Oct) AK1NS 618, WX3RHW 560, KD2CTI 151, K2TV 130, N2PQJ 125, N2WGF 120, K2KNB 93, N2RQ 73, KD2AKX 72, WB2ZEX 71. (Sept) WM2C 405, KT2D 390, WE2G 180, WA2BSS 152, N2JBA 130, N2VC 70, N2YJZ 70.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CO, CT, DE, EB, EMA, ENY, EPA, GA, IA, ID, IL, IN, KS, LA, LAX, ME, MI, MN, NC, NE, NFL, NH, NLI, NNJ, NTX, OH, OK, OR, SC, SD, SFL, SJV, SNJ, STX, TN, UT, VA, WCF, WMA, WI, WPA, WV, WY.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: DE, ENY, EWA, IA, ID, IN, GA, LA, MDC, ME, MI, MN, MO, NC, NFL, NM, NLI, OH, OK, SFL, TN, WTX, WV.

Brass Pounders League

BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

KK3F 4510, WB9FHP 2178, NX9K 1661, K6HTN 1211, KW1U 885, W8MAL 700, K6FRG 580, WB9JSR 528, K8ED 524.

BPL with Originations + Deliveries: NM1K 104.

The following station qualified for PSHR in previous months but has not been recognized in this column yet: (Nov) NX9K 1557, N9VC 555. (Oct) WA4STO 6770.

Silent Keys

Silent Keys Administrator, sk@arrl.org

It is with deep regret that we record the passing of these amateurs:

WA1DMT **Tschorn**, Douglas A., Sandgate, VT
WA1DTC **Bellemare**, Germain L., Dracut, MA
AA1DX **Cadorette**, Edward A., Easthampton, MA
W1EHN **Nelson**, Edward, Rochester, NH
W1FEZ **Vignos**, Joseph P., North Canton, OH
N1HUV **Ruscoe**, Richard F., Newtown, CT
K1IGP **Weirick**, Willis D., Old Greenwich, CT
N1JLG **Bell**, Timothy J., Fairview, PA
W1KGQ **Johnson**, Kenneth W., West Chatham, MA
N1LOO **Lees**, Beverly D., Framingham, MA
K1NXG **Steenhoff**, Fred C., Lima, NY
W1PDL **Bartram**, James F., Middletown, RI
W1PJL **Hastie**, Alexander F., Concord, MA
WA1QKJ **Kozinski**, Thomas G., South Attleboro, MA
W1RTD **Collin**, Laurier L., Jewett City, CT
W1VP **Meiler**, Gerald L., Upton, MA
KD1Z **Godwin**, Stephen B., Dothan, AL
KB1ZMB **Hovestadt**, Scott, Canton, MA
N2AGF **Williams**, Billy E., Cortland, NY
♦N2DH **Twaddell**, William E., Hackettstown, NJ
KA2DLE **Orsino**, James J., Greenville, NY
KB2ET **Schultz**, Alfred B., Mays Landing, NJ
W2FNY **Naumann**, Robert A., Skillman, NJ
KD2GHC **Clegg**, Thomas H., Rochester, NY
AE2J **Koenigsberg**, Allan M., Brooklyn, NY
W2JFN **Cox**, Mason F., Lockport, NY
WB2JKF **McCadden**, John B., Newark, NY
W2KTG **Durso**, Roy Joseph., Cocoa, FL
♦W2LAP **Levy**, Gerson A., Bronx, NY
KA2MJV **Nickerson**, Curtis J., Binghamton, NY
KS2N **De Rusha**, James O., Addison, NY
WA2NQS **Lisuzzo**, Frank C., Rochester, NY
WA2OKZ **Pietrucha**, Kenneth J., Toms River, NJ
K2RTC **Cernese**, Frank C., Huntington, NY
WA2TRT **Forth**, Joseph R., Wheeling, WV
W2VEC **Garofalo**, James P., Gallatin, TN
NO2Y **Dorman**, William H., Corning, NY
WA2ZNT **Kehoe**, Josephine, Garfield, NJ
W2ZWW **Vajo**, John S., Ocean Isle Beach, NC
W3AGU **Paules**, Dean L., York, PA
N3ASG **Rust**, William T., Penn Run, PA
WC3B **Resinger**, Robert E., Lansdale, PA
KB3CGC **Miller**, Hope H. Jr, Thurmont, MD
KB3EMH **Fargo**, Daniel L., Columbus, PA
K3JGZ **Shiffer**, Leon F., East Stroudsburg, PA
N3JXG **Jones**, Clyde T. Jr, Butler, PA
W3KCS **Gilborges**, Anthony J. Sr, Philadelphia, PA
KB3MIL **Jessop**, Ryan J., Aiken, SC
KA3MKF **Dillon**, Robert, Lansdale, PA
W3OER **Haube**, James C., Sarver, PA
WA3PUN **Bolton**, James E., Harrisburg, PA
K3PZ **Zora**, Paul R., Coraopolis, PA
K3SAX **Hutchison**, Robert E., Georgetown, KY
KA3SIS **Spencer**, Jerry, Mount Airy, NC
W3WXZ **Bernlohr**, George L., Butler, PA
N3YNA **Hearst**, William H. Sr, Wilkes Barre, PA
KJ4ALS **Bault**, Roger W., Fort Deposit, AL
KK4AZ **Howard**, Kenneth N., Summerfirld, FL
WA4CAN **Reese**, James H., Gastonia, NC
K4CMI **Phillips**, Ben B. Jr, Greensboro, NC
W4CXM **Snook**, Allen, Saint Augustine, FL
WD4DMX **Ludvigsen**, Roy R. Sr, New Bern, NC
K4DTT **Russ**, Howard G., North Myrtle Beach, SC
AK4F **Owen**, Stanley M. Sr, Huntsville, AL
KC4FET **Schatzman**, Cornelius W., Edgewood, KY
KK4GCH **Corbin**, William L., Mount Pleasant, SC
W4GFA **Allgood**, George F., Walhalla, SC
WO4H **Krensavage**, Alan S., Easton, PA
K4HUG **Nies**, Ronald J., Jacksonville, FL
WA4JNW **Greenwell**, Raymond H., Chattanooga, TN
KN4JR **Solomon**, Millard H., Winter Haven, FL
NM4K **Scott**, William H., Louisville, KY
KU4KN **Mort**, Donald C., Winchester, VA
W4KTL **Hamilton**, Phillip F., Statesville, NC
KI4KWC **Thomas**, Michael, Tallahassee, FL
W4LYR **Thompson**, William H., Watertown, TN
W4LZ **Royle**, Michael J., Ada, OH
KA4NIW **Smith**, Ernest J., Cheraw, SC
KJ4OAK **Sims**, James A., Bessemer, AL
WA4ONR **Akers**, Dorsey W., Fredericksburg, VA
KB4ONU **Day**, W. Darrell., Homestead, FL
K4OXF **Howard**, Kelway Louie II, Oxford, NC
♦W4PRO **Wise**, Marion A., Virginia Beach, VA
KK4RCT **Hickey**, Richard C. Jr, Cape Coral, FL
WB4RGS **Kirk**, Daniel E., New London, NC
WB4RSW **Ludvigsen**, Roy R. Jr, Amissville, VA
AE4RZ **Hale**, James D., Thomasville, GA
KA4RZZ **Sherk**, Thomas H., Birmingham, AL
WF4S **Duke**, James H. Sr, Franklin, TN
W4SQG **Pilafian**, Harry, Miami, FL
KI4TGG **Smith**, Charles Harwin, Wilmington, NC
KM4TV **Denton**, Steven W., Clarksville, TN
♦WB4UGG **Rowland**, John D., Savannah, GA
KD4UMG **Wright**, James S. Sr, Somerville, AL
WA4VUT **Eden**, William B. Jr, Mobile, AL
N4WGR **Faircloth**, Daryl, Spartanburg, SC
KJ4ZXN **Fripp**, Claude, Knoxville, GA
WB5AEP **Glenn**, Weldon T., Levelland, TX
N5AJT **Frase**, Lawrence E., Keller, TX
K5AWD **Jones**, William F., Oklahoma City, OK
W5BTF **Favorite**, Bounita, Baton Rouge, LA
N5DEE **Wagner**, William M. L., Lufkin, TX
WA5EFI **La Rocca**, Victor J. Jr, San Antonio, TX
K5FNW **Lincoln**, Joseph E. Sr, Spring, TX
KA5GCI **Worster**, Regina C. III, Bryan, TX
N5KBM **Kent**, Jan, Tyler, TX
KA5KJX **Witzel**, Donald A., College Station, TX
WB5NWN **Frohnapfel**, Larry M., Austin, TX
NN5O **Carmody**, James A., Magnolia, TX
N5OL **Traub**, Larry, Edmond, OK
N5OND **Hildebrand**, Michael H., Lakeview, AR
KF5QI **Wheatley**, Norman L., Houston, TX
♦AB5T **Pippin**, Richard D., Lawton, OK
KB5TVS **Hamilton**, Theresa M. J., Keller, TX
W5VFP **Woods**, Emmett, Metairie, LA
KB5VMR **Walling**, Donna L., Checotah, OK
N5XWB **Washburn**, Donald L., Sugar Land, TX
N5YJ **Chenette**, Eugene R., Allen, TX
WA5YRP **Wood**, Earl E., El Paso, TX
KG6BD **Johnson**, Carroll O., Redding, CA
KD6CPR **Hall**, Cathy L., Shasta Lake, CA
WB6DAC **Cowan**, Robert J., Costa Mesa, CA
KA6GZD **Foxen**, Patrick T., Solvang, CA
♦K6HMS **Freely**, William B., Newport Beach, CA
WB6IOH **Menard**, Donald R., Sacramento, CA
WA6LJD **Hodge**, Clarence H., Clovis, CA
W6MIP **Barnett**, Glen, Palm Springs, CA
K6MJS **Seitz**, Charles H., Chico, CA
WB6RWT **Hamilton**, Robert J., Milwaukie, OR
K6TGR **Shelton**, Robert C., Menlo Park, CA
♦AI6V **Cook**, Carl D., Las Vegas, NV
W6VRZ **Moulds**, Thomas O., Lompoc, CA
KF6WPQ **Welsh**, June J., Mountain View, CA
KD6ZJL **Enault**, Mary Ann, Sunnyvale, CA
KA7CDH **Panco**, Lawrence E., Packwood, WA
KB7DBI **Rackham**, A. B., Murray, UT
N7DES **Halversen**, Warren H. Jr, Hillsboro, OR
N7GYM **Nokleby**, Leroy, Salem, OR
W7KSO **Greatorex**, Richard O., Scottsdale, AZ
AB7LF **Curtis**, Steven E., Salt Lake City, UT
W7RKS **Yeager**, George A., Lacey, WA
K7RWH **Hassler**, Richard W., Rathdrum, ID
N7UM **McDonald**, Marvin L., Great Falls, MT
KB7VIL **Westergard**, Fred H., Salt Lake City, UT
♦W8DVI **Magyar**, Frank M., Canfield, OH
KD8ERB **Alvord**, Kenneth R., Archbold, OH
W8HWE **Bryan**, Theodore, Xenia, OH
K8IDN **Bornstein**, Steven A., Columbus, OH
K8IVC **Schelter**, Fred A., West Bloomfield, MI
K8LQB **Moyna**, James I. Jr, Lexington, IN
♦WB8NRK **Frazier**, Bob, Princeton, WV
KA8PGV **Retherford**, Robert R., Huber Heights, OH
WI8Q **Mauk**, Terry A., Toledo, OH
W8RCK **Kriscunas**, Randall C., Rockford, MI
W8RLM **Mervis**, Robert L., Solon, OH
N8TIC **Arft**, James G., Bradenton, FL
WB8ZCE **Patrick**, Michael D. Sr, Springfield, OH
WA9AWJ **McGlothlin**, Arthur R. Sr, Milwaukee, WI
WB9CUB **Huffman**, James D., Freeburg, IL
KA9FDV **Johnson**, Alan D., Elk Grove Village, IL
W9FE **Bough**, Jerome L., Hebron, IL
K9MAJ **Vonderschmitt**, John W., Washington, IN
KE9NZ **Carpenter**, Willie C., Edwardsville, IL
WB9RDN **Stavroff**, Robert, Kokomo, IN
W9SJW **Greene**, John R., Freeport, IL
K9TLR **Hamel**, William A. Jr, Chicago, IL
N9UFQ **Walker**, Kenneth O., Effingham, IL
KB9UJQ **Thompson**, Wanda J., Haines City, FL
KD9XP **Ruehrwein**, Edward W. Jr, Oak Park, IL
N9XQJ **Pitzlin**, David H., Beaver Dam, WI
KØDC **Connolly**, Donald H. Jr, Colorado Springs, CO
WØFBP **Kottke**, Glenn, Ankeny, IA
KSØFFL **Swope**, John S., Shawnee, KS
NØHXT **McClure**, Marshall D., Platte Woods, MO
WBØMDI **Rockefeller**, Lyle H., Bluffton, SC
KAØRHM **Saunders**, Everett "Lou" Jr, Bartlesville, OK
KØVC **McCuiston**, Donald J., Raytown, MO
KAØVTA **Karmann**, Jack L., Dixon, NE
KWØW **Judge**, Gregg P., Minneapolis, MN
WØWVO **Fraser**, Jerry K., Marine on Saint Croix, MN
NØXO **Seifert**, William J., Osage Beach, MO
WØYQG **Krout**, Harry L., Spring Hill, KS
VE7EFG **Buckle**, George, Kelowna, BC, Canada

♦ Life Member, ARRL

Note: Silent Key reports must confirm the death by one of the following means: a letter or note from a family member, a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc, 225 Main St, Newington, CT 06111.

New Store Celebration Pricing!

HAM RADIO OUTLET

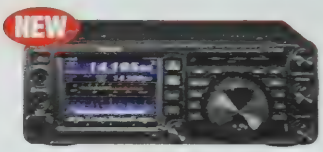
MARCH IS YAESU MONTH AT HRO!

FTDX5000MP Limited | *200W HF + 6M Txcvr*

• Internal Power Supply • Two Totally Independent Receivers • Super Sharp "Roofing" Filters • High Performance Yaesu Custom-designed 32-bit Floating Point DSP • True Analog Meter Precision

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP Down Conversion 1st IF **Call For Low Pricing!**



FT-991 | *HF/50MHz 2M/440 Transceiver*

• 160 M-440MHz - SSB/CW/FM/C4FM Digital/AM/RTTY/PSK • 100 W (2M/440 50 Watts) • 3.5" TFT full-color touch panel operation • High speed spectrum scope • Roofing filters: 3kHz & 15kHz • 32-bit high speed floating point IF DSP • 160-6 meter high speed automatic antenna tuner

FTDX1200 | *100W HF + 6M Transceiver*

• Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode, Auto Zero-In • Full Color 4.3" TFT Display

FT-450D | *A100W HF + 6M Transceiver*

• 100W HF/6M • Auto tuner built-in • DSP built-in • 500 memories • DNR, IF Notch, IF Shift **Call For Pricing!**

FT-857D | *Ultra Compact HF/VHF/UHF*

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)

Call For Our Low Price!

FT-2900R | *Heavy-Duty 75W 2M FM Transceiver*

• Massive heatsink guarantees 75 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-8800R | *2M/440 Mobile*

• V+U/V+V/U+U operation • V+U full duplex • Cross Band repeater function • 50W 2M/35W UHF • 1000+ memory channels • WIRES ready **Call Now For Low Pricing!**

FTM-400DR | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroS slot • 500 memory per band

FT1DR | *144/430 5W Digital Transceive*

• C4FM/FDMA • 1200/9600bps AX.25 APRS GPS Recvr Built-in • Dual Band Operation w/Du Receivers (V+V/U+V/V+U) • Wideband Receiv AM Bar Antenna Aircraft Receive • 1266 Memo Channels w/16 Char Alpha Tagging

Also Available in Silver!

VX-6R | *2M 220/440MHz HT*

• Wideband RX – 900 memories • 5W 2/440, 1.5W 220 MHz TX • LI-ION Battery - EAI system • Fully submersible to 3 ft. • CW trainer built-in

New Low Price!

VX-8DR | *50/144/220/440*

50/144/220/440 • 5W (1W 222 MHz) • Bluetoot optional • Waterproof/ submersible (3' for 30 mi • GPS APRS operation optional • Li-ion Hi-capaci battery • Wide band Rx

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

YAESU
The radio

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX (877) 455-8750
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 829-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

Now Silver!

New Store Celebration Pricing!

HAM RADIO OUTLET

14 STORE BUYING POWER!

C-7850 | HF/50MHz Transceiver

1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function Enhanced mouse operation for spectrum scope • More features

C-7700 | HF/50MHz Transceiver

ne Contester's Rig • HF + 6m operation • +40dBm ultra high intercept oint • IF DSP user defined filters • 200W output power full duty cycle Digital voice recorder

C-7600 | All Mode Transceiver

100W HF/6m Transceiver, gen cov. receiver • Dual DSP 32 bit • Three ofing filters- 3, 6, 15khz • 5.8 in WQVGA TFT display • Hi-res real time ectrum scope

C-9100 | The All-Round Transceiver

HF 50MHz 144 430 (440) MHz and 1200MHz** coverage • 100W on /50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz** • Double perheterodyne with image rejection mixer

C-7410 | HF/50MHz Transceiver

2-bit floating point DSP unit • Double Conversion Super-Het ceiver • Built-in 15kHz 1st IF Filter • Built-in Band Scope • Large, lti-function LCD • RTTY Demodulator/Decoder • USB for PC control

IC-7200 | HF Transceiver

• 160-10M • 100W • Simple & tough with IF DSP • AGC Loop Management • Digital IF Filter • Digital Twin PBT • Digital Noise Reduction • Digital Noise Blanker • USB Port for PC Control

IC-718 | HF Transceiver

• 160-10M* • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-7100 | All Mode Transceiver

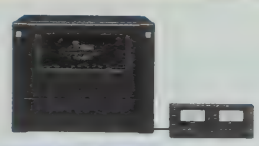
• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

ID-5100A | VHF UHF Dual Band Digital Transceiver

• Analog FM D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch • FM Analog DV Repeater List Function

IC-V8000 | 2M Mobile Transceiver

• 75 watts • Dynamic Memory Scan • CTCSS/DCS encode/decode w tone scan • Weather alert • Weather channel scan • 200 alphanumeric memories



IC-PW1 | HF/50 MHz Amplifier

• Wide freq. coverage - 1 kW from 1.8 MHz to 60 MHz amateur bands only • Wide ALC adjustable range • Full duty cycle • Auto antenna tuner built-in • Auto AC input voltage selector is employed • Current (Ip), Voltage (Vp), temperature, SWR and output power protectors are available

IC-2300H | VHF FM Transceiver

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

ID-880H | Analog+Digital Dual Bander D-STAR

• D-STAR DV mode operation • DR (D-STAR repeater) mode • Free software download • GPS A mode for easy D-PRS operation • One touch reply button (DV mode) • Wideband receiver D-STAR ready

IC-V80 | HD 2 Meter FM Transceiver

• Tough construction • 750mW loud audio • Powerful 5.5W of output power • IP54 and MIL-STD-810 rugged construction • Built-in CTCSS/DTCS • WX channel & weather alert function

ID-51A | VHF UHF Dual Band Transceiver

• 5/2.5/1.0/0.5/0.1W Output • RX: 0.52–1.71, 98–174, 380–479 MHz** • AM/FM/FM-N/WFM/DV • 1304 Alphanumeric Memory Chls • Integrated GPS • D-STAR Repeater Directory • IPX7 Submersible D-STAR ready

ID-31A | UHF Digital Transceiver

5W Output Power • FM Analog Voice or D-STAR DV Mode • Built-in GPS Receiver • IPX7 Submersible • 1,252 Alphanumeric Memory Channels

D-STAR ready

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

ICOM

AHEIM, CA 0) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	FLANO, TX (877) 466-8750
URBANK, CA 7) 892-1745	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-8476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

New Store!

past 60M Band. **Frequency coverage may vary. Refer to owner's manual for exact specs. † Optional UX-9100 required. ◆ Instant savings valid to 3/31/15. Contact HRO for promotion details. ©2015 HAM RADIO OUTLET, INC. All rights reserved. Prices, specifications and availability subject to change without notice. Not responsible for typographical errors. Free shipping (Hawaii, Alaska and Canada: Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, TX: Advertised merchandise may be sales tax. Prices, specifications and availability subject to change without notice.

New Store Celebration Pricing!

HAM RADIO OUTLET

14 STORE BUYING POWER!

TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

Call For Special Price!

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TS-480SAT/HX | *HF + 6M Transceiver*

• 480HX 200W HF & 100W 6M (no tuner) • 480SAT 100W HF 6M w/AT • Remotable w/front panel/speaker • DSP built-in

Call Now For Low Price!

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TH-D72A | *2M/440 HT w/extended*

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in G Built-in USB, digipeater • Echolink® compati • Mil-Spec STD810

Call For Special Low Price!

TH-F6A | *2M/220/440*

• Dual channel receive • .1 - 1300 MHz (cell blocked) RX • FM, AM, SSB • 5W 2M/220/440 TX, FM • 435 Memories • Li-Ion Battery

Call For Low Price!

TS-2000/2000X | *HF/VHF/UHF Transceiver*

• 100W HF, 6M, 2M • 50W 70CM • TS-2000X 10W 1.2GHz • Built-in TNC, DX packet cluster• IF Stage DSP • Backlit front key panel

Call For Special Price!

TM-281A | *2 Mtr Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TH-K20A | *2M Handheld*

• 2M 5.5W • VOX • CTCSS/DCS/1750 Bu built-in • Weather alert

Call For Special Low Price!

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

KENWOOD

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7385	WOODBRIDGE, VA (800) 444-4799	PLANO, TX (877) 453-8750
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9823	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.CO

New Store!

✦Kenwood coupons expire 2/28/15. Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another
Some items add sales tax. Prices, specifications and descriptions subject to change without notice

New Store Celebration Pricing!

HAM RADIO OUTLET

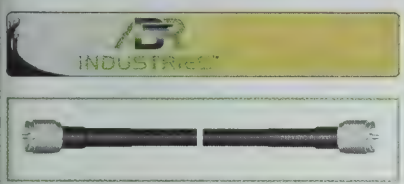
14 STORE BUYING POWER!

ACOM

ACOM-1000

• HF and 6 Meter 1KW Amplifier • Match 3:1 SWR with No Tuner • User Friendly QSK Operation • LCD Message Display • Single 4CX800a Tube • Vacuum Antenna Relays

Call For Additional ACOM Products!



- *218XATC-PL-(length) RG8x (240UF) w/PL259 Connectors Each End. Weather-Proof Heat Shrink Tubing.*
  - *Stranded Center Conductor.*
  - 95% TC Braid + bonded 100% Foil Shield.
  - *Very Flexible, Light Weight, and Smaller than RG8 sizes.*
  - Non-Contaminating-UV Resistant-Direct Burial-Black Jacket.

- *235-5X-(length) 1" Wide Tin-Copper w/Ring Terminals Each End. Adhesive-Lined Heat Shrink Tubing.*
  - *Grounding Braid Heavy Grade.*
  - Construction: 38x48x18/864 7ga 85 Amps.
  - *Easy termination: ¼" Stud Ring Terminals.*

REMOTE RIG

RRC-1258 MkII-S-Set

This set of interfaces allows remote control of your Amateur Radio Station via Internet in a user-friendly and cost effective way! RemoteRig gives you control of the radio coupled with crystal clear TX & RX audio and sending CW with your own Paddle!

New! Now Stereo Version for Dual Receiver radios.

Works with all Computer-controllable radios from:
Alinco - Elecraft - ICOM - Kenwood - Yaesu

For radios with detachable front panels no PC is required for:
TS-480HX/SAT; TS-2000 (RC-2000 req'd); IC-703/Plus; IC-706 series; DX-SR8T; IC-2820H; IC-R2500

Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

Available exclusively from all HRO locations!

US TOWER

MA-40

• 40' Tubular Tower

Call For Latest Pricing!

MA-550

• 55' Tubular Tower • Handles 10 sq. ft. at 50 mph • Pleases neighbors with tubular streamlined look

Call For Latest Pricing!

All US Towers shipped by truck; freight charges additional.

BUY FROM HRO. The World's Largest US Tower Dealer

TX-455

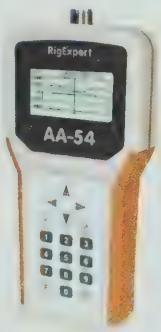
• 55' freestanding crank-up • Handles 18 sq. ft. @ 50 mph • No guying required • Extra-strength construction • Can add raising and motor drive accessory • Towers rated to EIA specifications • Other models available at great prices!

Revolutionary Radio Interfaces

Rig control interfaces with CAT for all popular radios. CW (WinKey emulation), digital modes including RTTY, PSK, MFSK, MT63, SSTV, PACTOR and many more. Experience untethered connection to the computer using the new WTI-1 wireless transceiver interface.

State of the Art Antenna Analyzers

Great selection of antenna analyzers designed for testing, checking, tuning or repairing antennas and feedlines with frequency ranges and accuracy to meet the needs of even the most discriminating amateur radio operator.



RigExpert

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

HRO is owned and operated by active hams!

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX (877) 465-8750 New Store!
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-0623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, TX, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

DX ENGINEERING®

Extended Phone Hours

Sales: 1-800-777-0703
Monday-Friday: 8:30 am to Midnight
Saturday & Sunday: 8:30 am to 5 pm

Tech: 1-330-572-3200
Monday-Friday: 8:30 am to 7 pm

DX Engineering.com Online 24/7

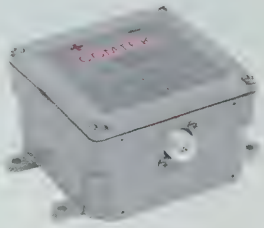
All Times Eastern
Country Code: **+1** Sale Code: **1503QS**

Photo shown with optional 6 Meter Add-On Kit listed below.

Navassa-5 Multi Band Yagi

- Excellent performance in a relatively compact antenna
- Broadband coverage of the 10, 12, 15, 17 and 20 meter bands
- 2-element monoband performance on all 5 bands
- Aluminum and stainless steel construction, no rivets or worm clamps
- Rugged 12', 2" O.D. boom
- Maximum Turning Radius: 19.45'
- Longest Element: 36.8'
- Wind Rating: 100 mph
- Approximate Weight: 52 lbs.
- The 1:1 Comtek Dual-Core Balun is recommended

JKA-NAVASSA5	Navassa-5 Yagi Antenna	**$1185.00**
JKA-NAVASSA5PLUS	6 Meter Add-On Kit	**$80.00**
COM-BAL-11140T	Comtek 1:1 5 kW Dual Core Balun	**$118.95**



COM-BAL-11140T

DXE-UT-KIT4

Coaxial Cable Prep Tools for Solder-On Connectors

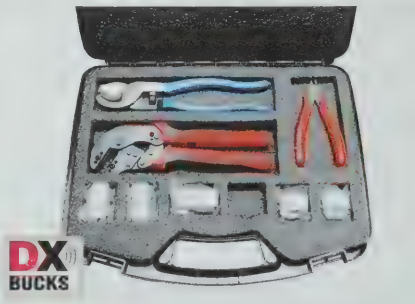
Using a two-step process, these prep tools are the ideal way to prepare your foam or solid dielectic coaxial cable for a solder-on connector.

DXE-UT-8213	Cable Stripper for RG-8, RG-213, and Similar Sizes	**$49.95**
DXE-UT-808X	Cable Stripper for RG-8X, 9258, and Similar Sizes	**$49.95**
DXE-UT-80P	PL-259 Assembly Tool	**$22.95**
DXE-UT-80N	2-Piece N Connector Tool	**$22.95**
CNL-911	Coax Cable Cutters	**$18.97**
DXE-170M	Precision Shear Cutters	**$7.95**

The tools also come in cost-saving kits, complete with case.

DXE-UT-KIT3	Basic Coax Cable Prep Kit	**$119.95**
DXE-UT-KIT4	Complete Coax Cable Prep Kit	**$199.95**

DXE-UT-KIT3 eligible for 10 DX Bucks, DXE-UT-KIT4 eligible for 20 DX Bucks, see DXEngineering.com for details.



DXE-UT-KIT-CRMP2

Ultra-Grip 2 Crimp Connector Hand Tool Kit

This kit includes everything you need to make professional-quality crimps on coaxial and Powerpole® connectors.

DXE-UT-KIT-CRMP2	Complete Kit, 5 Die Sets;	**$154.95**
DXE-UT-CRMP2	Crimp Tool for RG-8U/ LMR-400 Size Cable	**$49.68**
DXE-UT-CRMP2-8X	Crimp Tool for RG-8X/ LMR-240 Size Cable	**$49.68**
DXE-UT-CRMP2-PWR	Crimp Tool for Powerpole® 15, 30, 45A	**$49.68**
DXE-UT-DIE-INS	Crimp Die for Insulated 22-10 AWG Terminals	**$19.73**
DXE-UT-DIE-UNIS	Crimp Die for Uninsulated 22-8 AWG Terminals	**$19.73**

DXE-UT-KIT-CRMP2 eligible for 10 DX Bucks, see DXEngineering.com for details.

Dual Vertical Array

DX BUCKS 45

The Dual Vertical Array is an easy-to-install two-element vertical antenna phasing system that offers great HF performance. It uses a new design to increase array efficiency by eliminating the waste load port found on previous systems. The array can handle 2 kW, with a front-to-back over 20 dB and up to 3 dB of gain over a single vertical.

The DX Engineering Dual Vertical Array systems are available for the 160, 80 and 40 meter bands. More bands are coming soon.

DXE-DVA-160-P	Dual Vertical Array, 160M with Controller	**$469.90**
DXE-DVA-80-P	Dual Vertical Array, 80M with Controller	**$454.90**
DXE-DVA-40-P	Dual Vertical Array, 40M with Controller	**$439.90**

Eligible for 45 DX Bucks, see DXEngineering.com for details.

Receiver Guard 5000

Protect your sensitive receiver against high levels of RF from strong or nearby signals. DX Engineering's Receiver Guard 5000 is perfect if you have a receive antenna saturated with high RF levels. It is also useful for Field Day, SWL or if your neighbor generates a lot of RF.

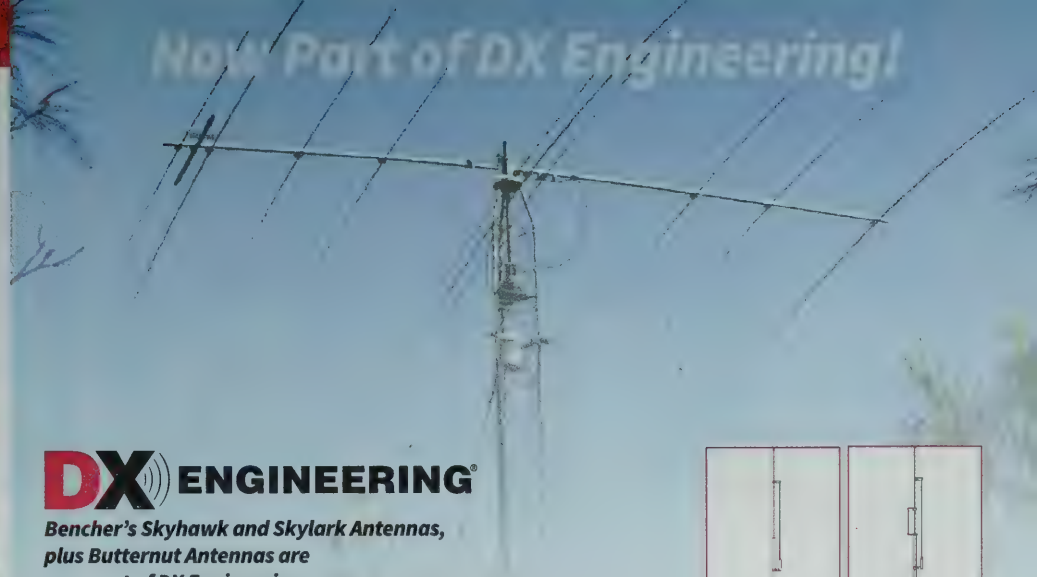
The RG-5000's advanced design limits strong signals with minimal harmonic noise and is RF transparent at normal receiver signal levels. Designed for the world-class multi-transmitter contest station K3LR, it offers 100% protection to expensive transciever front-ends. The RG-5000 provides performance and frequency coverage superior to other devices. At a continuous input of 10 W maximum, output is only +10 dBm (83 dB over S-9), and insertion loss is under 0.15 dB from 0.5 to 50 MHz.

DXE-RG-5000	Receiver Guard 5000	**$74.95**

Copper Ground Bus Wall Mount

As the foundation of your single-point ground system, DX Engineering's Cooper Ground Bus Wall Mount can protect your valuable gear from voltage spikes and reduce electrical noise in your signal path. The 9-inch bracket surface has plenty of room for two PolyPhaser flange-mount or four Alpha-Delta TT/ATT3G50 series coaxial surge protectors. The heavy-gauge tempered copper assembly is strong enough to handle the weight of long cable runs. It can be installed indoors or outdoors, and hardware is included.

DXE-GBWM	Copper Ground Bus Wall Mount	**$65.95**



DX Engineering is the Best Place to Get Coax, Here's Why:

- 100% High Voltage (Hi-Pot) Tested
- Weatherproof: Adhesive Shrink Tubing Seals Connections
- Silver-plated PTFE-insulated Connectors
- Hand Crafted by Top Techs
- Also Available by the Foot.

DX Engineering Cable Assemblies are built by our techs, right here in Ohio. They're fully tested and are ready for installation in your shack. For all lengths and connector options, visit DXEngineering.com.

Black PVC Jacket

DXE-8U 50 Ω Low-Loss Foam Dielectric Cable

- .405" high-flex PVC jacket

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	5.4 kW	93%
0.5 dB @ 10 MHz	4.1 kW	90%
0.9 dB @ 30 MHZ	2.2 kW	81%
1.2 dB @ 50 MHz	1.8 kW	77%
2.2 dB @ 150 MHz	1.0 kW	60%

UV-Resistant, Non-Contaminating, Black PVC Jacket

DXE-213U 50 Ω MIL-Spec Cable

- .405" Type II UV-resistant jacket is non-contaminating and suitable for outdoor use

Attenuation per 100 feet	Power Rating	Efficiency
0.4 dB @ 5 MHz	4.9 kW	90%
0.6 dB @ 10 MHz	3.4 kW	87%
1.0 dB @ 30 MHz	2.0 kW	79%
1.3 dB @ 50 MHz	1.5 kW	73%
2.4 dB @ 150 MHz	0.9 kW	57%

UV-Resistant, Non-Contaminating, Black PE Jacket

DXE-400MAX 50 Ω Premium Low-Loss Cable

- Gas-injected foam, polyethylene dielectric bonded tape foil covered by a braided copper shield
- .405" low-density UV-resistant polyethylene jacket is ideal for outdoors
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	6.9 kW	93%
0.5 dB @ 10 MHz	4.8 kW	90%
0.8 dB @ 30 MHz	2.8 kW	83%
1.1 dB @ 50 MHz	2.1 kW	79%
1.8 dB @ 150 MHz	1.2 kW	65%
3.3 dB @ 450 MHz	0.7kW	47%

UV-Resistant, Black PE Jacket

DXE-8X Low-Loss Foam Dielectric Cable

Known as RG-8X or Mini-8

- Very flexible; ideal for short, in-shack jumper cables
- .242" Type II jacket is non-contaminating and UV-resistant
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.6 dB @ 5 MHz	3.0 kW	86%
0.9 dB @ 10 MHz	2.2 kW	81%
1.4 dB @ 30 MHz	1.2 kW	69%
2.0 dB @ 50 MHz	0.9 kW	62%
3.8 dB @ 150 MHz	0.4 kW	42%

DX ENGINEERING

Bencher's Skyhawk and Skylark Antennas, plus Butternut Antennas are now part of DX Engineering

For years, Amateur Radio operators have relied on these antennas for both HF contesting and DXing. Now, the Skyhawk, Skylark, and every Butternut Antenna model will be manufactured and sold exclusively by DX Engineering.

As two of the premier HF multi-band Yagis on the market, the DX Engineering Skyhawk and DX Engineering Skylark both feature rugged construction and a relatively compact size. Butternut HF Multi-Band Vertical Antennas offer excellent HF performance, and are easy to set up and tune. All antennas deliver the perfect combination of performance and operating ease.

DX Engineering also carries all the service, repair, and replacement parts you'll need to keep these antennas in excellent condition.

Made in USA

DX Engineering's Revolutionary PL-259 Connector*

A "Better Mousetrap" Approach to Your Cable.

This brand new PL-259 design has a full-diameter, full-length soldered center pin, which means it will fit snugly into a well-worn SO-239. The large center pin also makes it easier to flow solder inside, further securing the conductor. The silver plated and deeply knurled shell has precise threads to promote a solid connection with the SO-239. Each of these PL-259 connectors is insulated with a PTFE dielectric for exceptional RF characteristics. You can only get this new connector design at DX Engineering.

***Patent Pending**

The New PL-259 is Used Exclusively on DX Engineering Cable Assemblies.

DX Engineering starts with the highest-performance, low-loss 8U, 213U and 400MAX coaxial cable, and then finishes each assembly with its revolutionary new PL-259 connectors. The connectors feature a machine-crimped shield that provides a 360° electro-mechanical connection. Every weather-shielded, hand-soldered assembly is hi-pot and continuity tested in the USA. They come in multiple lengths; custom lengths are also available.

Always the Best Cable at the Lowest Price

- Made to DX Engineering's rigid specifications
- Available in full spools or cut to your custom length

Bulk Cable	Impedance	Length	Price
Low-Loss Mini-8 Cable			
DXE-8X	50 Ω	per foot	**$0.38**
DXE-8X-1000	50 Ω	1,000'	**$299.99**
Low-Loss Cable			
DXE-213U	50 Ω	per foot	**$0.89**
DXE-213U-500	50 Ω	500'	**$389.95**
DXE-11U	75 Ω	per foot	**$0.52**
Premium Low-Loss Cable			
DXE-400MAX	50 Ω	per foot	**$0.92**
DXE-400MAX-500	50 Ω	500'	**$399.95**
Low-Loss Foam Cable			
DXE-8U	50 Ω	per foot	**$0.84**
DXE-8U-500	50 Ω	500'	**$369.95**
Highly Flexible Cable			
DXE-58AU	50 Ω	per foot	**$0.29**
Flooded Jacket Cable			
DXE-F6-CTL	75 Ω	per foot	**$0.19**
DXE-F6-1000	75 Ω	1,000'	**$149.95**

Sign up at DXEngineering.com to receive news & specials by email and request a FREE Catalog!

DX® ENGINEERING

Extended Phone Hours

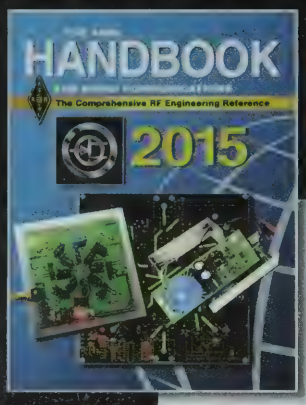
Sales: 1-800-777-0703
Monday-Friday: 8:30 am to Midnight
Saturday & Sunday: 8:30 am to 4 pm

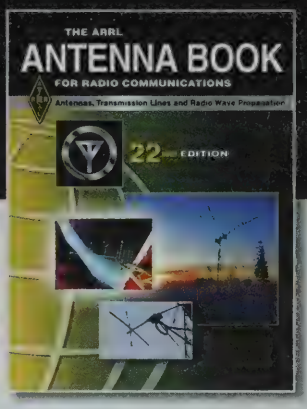
Tech: 1-330-572-3200
Monday-Friday: 8:30 am to 7 pm

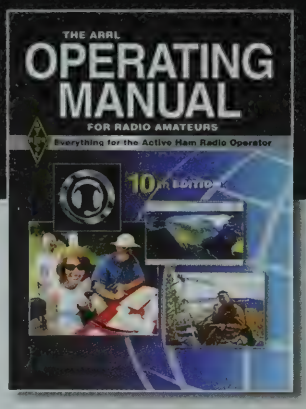
DX Engineering.com Online 24/7

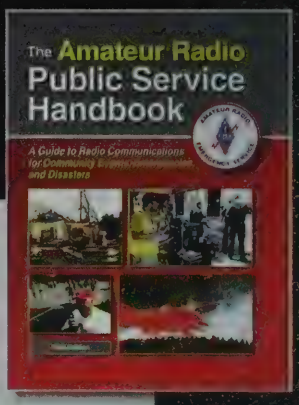
All Times Eastern
Country Code: **+1** Sale Code: **1503QS**

Stay connected:

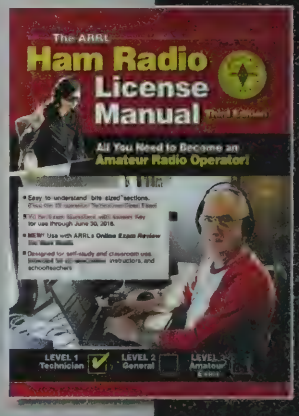




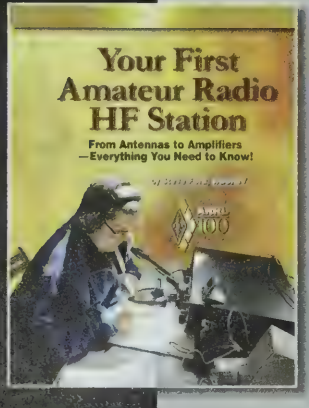


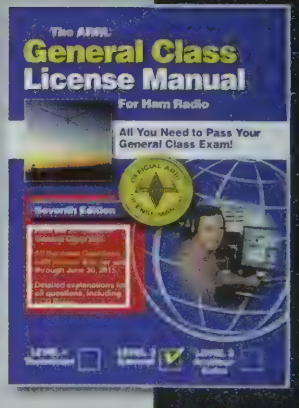

The Amateur Radio
Public Service
Handbook
A Guide to Radio Communications for Community Events, Communication and Disasters

Stay in the Know!

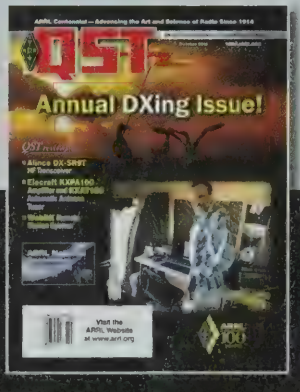


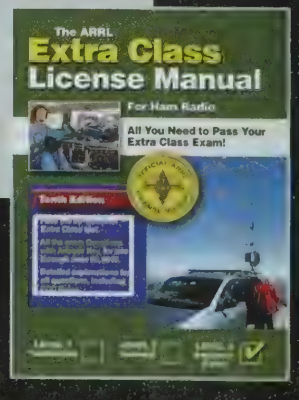
ARRL Publications and Journals
www.arrl.org/shop





ARRL, the national association for Amateur Radio®
Devoted entirely to Amateur Radio





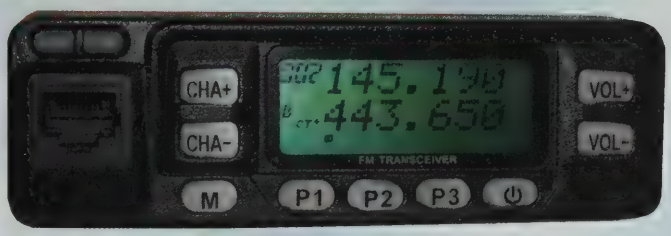
R&L Electronics®

1315 Maple Ave HAMilton, Oh 45011
http://randl.com sales@randl.com
Local/Tech 513-868-6399
Fax 513-868-6574
(800)221-7735

Small Size
4 3/4" x 1 1/2" x 3 3/8"

JETSTREAM

2m/70cm Dual Band Mobile
JT270M



10 Watts
Includes programming cable and software
199 Memory Channels
CTCSS/DCS Encode/Decode Built In
Touch Tone Microphone Included

$139.95 Free Shipping

Daily Specials at www.randl.com

YAESU
The radio

FT450D

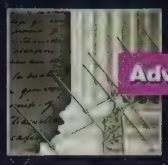
The FT-450D is a compact yet superb HF/50MHz radio with state-of-the-art IF DSP technology configured to provide World Class performance in an easy to operate package. New licensees, casual operators, DX chasers, contesters, portable / field enthusiasts, and emergency service providers…This Radio is for YOU! Illuminated Key Buttons, 300Hz / 500Hz / 2.4 kHz CW IF Filter, Front Feet Stand, Classically Designed Main Dial and Knobs, Dynamic Microphone MH-31A8J Included

Best Bang for Your Buck

HF, 6m, 100 Watts, Automatic Antenna Tuner, IF-DSP

$689.95* Free Shipping

**After $50 Mail In Rebate. 739.95—50 mail in rebate = 689.95. Limited Time Special*



Advocacy

Membership

Public Service

Education

Technology

Join or Renew!

Devoted Entirely to Amateur Radio

ARRL 100 YEARS

Includes QST

www.arrl.org/join

Membership Application

☑ Membership options (circle your choice/s)

	1 Year	2 Years	3 Years	
Regular	$39	$76	$111	Monthly *QST* via standard mail for US members
Canada	$49	$93	$132	Monthly *QST* via standard mail for Canadian members
International *QST*	$62	$118	$167	Monthly *QST* via air mail for international members
International – no printed *QST*	$39	$76	$111	Digital *QST* only
Family	$8	$16	$24	Reside at the same address as the primary member, no additional *QST*. Membership dates must correspond with primary member.

Membership includes $15 per year for subscription to *QST*. Dues subject to change without notice and are nonrefundable.

Blind and youth rates are available. Contact ARRL for more details.

Additional membership options available online at www.arrl.org/join.

Name _____ Call Sign _____

Street _____ City _____ State _____ ZIP _____

E-mail _____ Phone _____

Family Member Name _____ Call Sign (if any) _____

☑ Payment Options

☐ Visa ☐ MasterCard ☐ Amex ☐ Discover ☐ Check Enclosed

☐ Total enclosed payable to ARRL $ _____

☐ I do not want my name and address made available for non-ARRL related mailings.

Card Number _____ Expiration Date _____

Cardholder's Signature _____

Join Now

ONLINE: **www.arrl.org/join** PHONE: **1-888-277-5289 (US)**
ARRL•225 Main Street•Newington, CT 06111-1494
Phone: 860-594-0338 • FAX: 860-594-0303

Source Code: QST 2/2014

— Yaesu System Fusion —

FT-1DRBHD 2M/440 FM HT

• TX: 2M/70cm • Wideband RX: 500kHz-999MHz (less cellular with AM/FM broadcast) • Power: 5W • Analog and Digital (12.5kHz C4FM FDMA) • Integrated GPS • CTCSS/DCS Encode & Decode • WX Receiving with WX Alert • Digital Group Monitor Function • GSM (Group Short Message) • Snapshot Function with optional Speaker Mic

$100 MAIL-IN REBATE

FTM-400DR 2M/440FM Transceiver

TX: 2M/70cm RX: 108-470/800-999MHz (cell blkd) • Power: 50W FM • C4FM FDMA w/GPS for APRS (1200/9600bps) • Packet Ready Color display • Spectrum scope • ARTS • Bluetooth • Twin RX• MicroSD slot • 12/30kHz filters • 500 memories/band

FT-270R 2M FM HT

• TX: 144-148 • RX: 136-174 • Power: 5/2/0.5W • 200 Memories • Extra large LCD display & speaker

FT-60R 2M/440 MHz HT

•TX: 144-148, 430-450 • RX: 0.5-999 • 5 Watts RF Output • Features wideband receive from 108-520 and 700-999 MHz (Cellular Blocked) • Emergency Auto ID System • Over 1000 Memories

VX-8DR 6M/2M/440 FM HT

• TX: 50-54, 144-148, 222-225, 430-450 MHz • RX: 0.5-999 MHz (cell blocked) • 1200+ Memories • Power: 5/2.5/1/0.05W (1.5W on 220 MHz) • Optional GPS Unit FGPS-2 with either CT-136 adapter or MH-74A7A hand microphone provides APRS® data

$30 MAIL-IN REBATE

FT-1900R Rugged, high-performance, 2M FM Transceiver

• TX: 144-148 MHz • RX: 136-174 MHz, 144-146 MHz • Power: 55/25/10/5W • 200 Memories (6 Character) • 8 Memory Banks • 55 Watts Output • Busy Channel Lock-Out • Automatice Power-Off • Automatic Repeater Shift • Severe Weather Alert • CW Trainer • DTMF Memories • Weight 2.6 lbs • Backlit DTMF Mic

$50 MAIL-IN REBATE

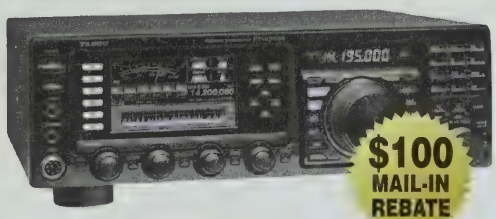
FT-450D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 10-100W • Memories: 500 • Built-in Automatic Antenna Tuner • IF DSP • Same as the original FT-450AT with new features: Key illumination, Foot stand, Selectable 300 Hz/500 Hz/2.4 kHz CW IF Filters • Classically designed main dial and knobs • dynamic microphone

$100 MAIL-IN REBATE

FTDX-1200 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Triple Conversion with 32-bit floating point DSP • Power: 100W • Built-in Automatic Antenna Tuner • 40 MHz IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • FM & AM Wide and Narrow modes included • Optional built-in FFT UNIT supports advanced functionality including AF-FFT Scope • RTTY/PSK31 Encode/Decode • CW Decode and CW Auto Zero-in • Full Color 4.3 in. TFT Color Display • USB port



$100 MAIL-IN REBATE

FTDX-3000D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 5-100W • Large TFT color display • High-speed spectrum scope • High end receiver based off of the FTDX-5000 • IPO • Built-in USB interface • Remote Control Capability • High-speed auto antenna tuner • RTTY/PSK31encode/decode included • 5 Digital voice messages

$200 MAIL-IN REBATE

FTDX-5000MP *Limited* HF/6M Transceiver

• TX: 1.8-29.7, 50-54 MHz Power: 10-200W on CW, SSB, FM, RTTY & PKT and 5-50W on AM • RX: 0.03-60 MHz • 99 Memories • Agressive 112dB range • +40dBm IP3 or 3rd-order Intercept Range • High stability ±0.05ppm OCXO • 32-bit Floating Point DSP • Variable CW Audio Peak Filter, and High/Low-Cut DSP filtering • 300 Hz, 600Hz, 3 kHz, 6kHz and 15 kHz Roofing Filters

YAESU mail-in rebates expire on 3/31/2015. Please check Web or Call for Current Promotions.

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
800-558-0411
fax: 414-358-3337
milwaukee@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
800-321-3594
cleveland@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
800-327-1917
orlando@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
800-634-6227
lasvegas@aesham.com

1-800-558-0411
aesham.com

MasterCard VISA DISCOVER NOVUS Cards

FOLLOW US ON TWITTER!
twitter.com/K9AES

TRADE UP TO YAESU
CALL NOW FOR A QUOTE!

Radios by YAESU
The radio

We Want to Earn Your Business!

Main Trading Company

Christine and Richard

Got Questions? For Friendly Service, Give Us a Call 903-737-0773

- ★ We take trade ins
- ★ We help you get the gear you really want
- ★ In Store Financing available
- ★ Layaway available
- ★ Lowest price extended warranty plan in the industry with plans up to four years
- ★ New and Used ham gear!
- ★ See our site for details.

ID-5100A
Digital Transceiver
Innovative 2m/70cm Transceiver with Touch Screen and Internal GPS
Intuitive Touch Screen Operation
V/U, V/V, U/U Dual Receive
DV Dualwatch
GPS Receiver
DV/FM Repeater List Function
Built-in CTCSS/DTCS Encoder and Decoder

IC-2730A
VHF/UHF Dual Band Transceiver
50 watts of Output on VHF and UHF
VHF/VHF, UHF/UHF Simultaneous Receive
Optional VS-3 Bluetooth® Headset
Easy-to-See Large White Backlight LCD
Built-in 50 CTCSS and 104 DTCS Tones with Split Tone Function

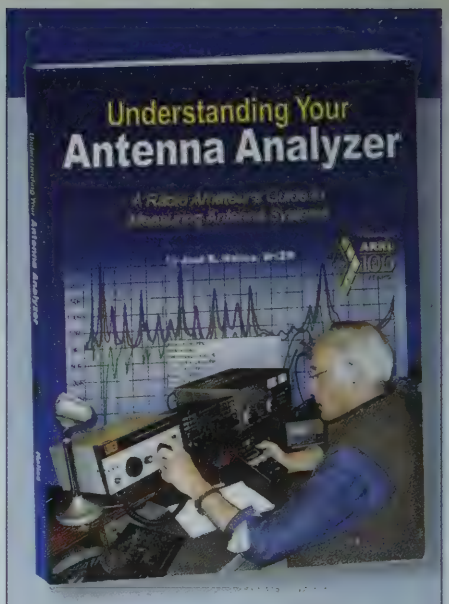
MAIN TRADING COMPANY

MTC WWW.MTCRADIO.COM

2707 Lamar Ave.,
Paris, TX 75460

Come see us when you're in Paris, Texas!

www.MTCradio.com



Understanding Your Antenna Analyzer

By Joel Hallas, W1ZR

Fine Tune Antenna Performance!

Antenna analyzers are arguably one of the most important pieces of equipment in an Amateur Radio station. Even the simplest antennas can benefit from using one, and your success on the air may depend on it, but only if you understand and avoid the common pitfalls.

Understanding Your Antenna Analyzer is an introduction to the various types of analyzers available, their component parts, how they operate and how to utilize them to get the best possible data. It discusses how to adjust your antenna, enhance your antenna analyzer and the ways certain analyzers can be used as general purpose test instruments in an Amateur Radio lab. Includes product review testing and an in depth look at representative antenna analyzers available today.

Includes:

- Why Measure Antennas?
- Making Antenna Measurements
- Information Available from an Antenna Analyzer
- Hooking it Up and Making it Play
- Adjusting Your Antenna
- Taking the Feed Line Into Account
- Other Antenna Analyzer Applications
- Enhancing Your Antenna Analyzer
- A Survey of Available Antenna Analyzers

ARRL Order No. 2889
Special ARRL Member Price!
Only $22.95* (regular $25.95)

*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 11/2013

50th Anniversary Limited Edition Available From AES

ID-51A
Dual Band Handheld

ICOM

• TX: voice memory for repeat calls • Integrated GPS receiver with GPS loggins function • Repeater search function searches up to 20 nearby repeater sites • Battery pack, BP-271 • Voice synthesizer function announces frequency, mode and call sign • Voice memory function records incoming and outgoing calls and can be used as a voice recorder • Large full dot-matrix display • DR (D-STAR repeater) mode operation makes it easy to access D-STAR repeaters • micro SD card slot for voice, log data storage and data cloning • Antenna, FA-S270C • Cloning software • Wall charger • Belt clip • Hand strap

Only 5,000 units will be available worldwide. Be sure to get your Anniversary Edition while supplies last.

Icom IC-2730A
144/440 MHz Mobile

NEW!

• TX: 144-148 MHz • RX: 118-174 MHz • Power: 50, 15 and 5 Watts • Independent controls for each band • 50 watt output is available on both bands • Enjoy 1000 memory channels • 2 call channels • 50 program scan edges memories • Wideband receive coverage is 118-137 [AM mode], 137-174 and 375-550 MHz • Independent VHF/UHF bands support crossband repeat as well as V/V and U/U simultaneous receive.

$100 INSTANT COUPON

IC-7410 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W • 15kHz 1st IF Filter and optional 3kHz & 6kHz filters to protect against strong unwanted adjacent signals • Much faster DSP unit compared to the IC-746PRO • Automatic antenna tuner • USB connector for PC control

ICOM Instant Coupons expire on 03/31/2015. Please check Web or Call for Current Promotions.

$300 INSTANT COUPON

IC-7100
HF/VHF/UHF All Mode Transceiver

• TX: HF/6M/2M/440MHz • RX: 0.03-199.999, 400-470 MHz MHz • Power: 2-100W/2-50W (2M)/2-35W (440) • Memories: 495, 900 D-Star Repeater Channels • Remote Head • Intuitive Touch Screen Interface • D-Star DV Mode • Detachable Angled Screen • SD Memory Card Slot • USB Port • Optional RS-BA1 Remote Control Software • Optional RC-28 USB Remote Encoder

$150 INSTANT COUPON

IC-7600
HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W • Memories: 101 • 5.8 inch color screen • High-resolution real spectrum scope • Automatic antenna tuner

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
800-558-0411
fax: 414-358-3337
milwaukee@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
800-321-3594
cleveland@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
800-327-1917
orlando@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
800-634-6227
lasvegas@aesham.com

1-800-558-0411
aesham.com

FOLLOW US ON TWITTER!
twitter.com/K9AES

TRADE UP TO ICOM
CALL NOW FOR A QUOTE!

Radios by ICOM

Array Solutions

Your Source for Outstanding Radio Products

FT5ZM Amsterdam Island 2014 DXpedition

Professional Grade Equipment from Array Solutions

AN Structures, LLC and Array Solutions – Back Together Again

AN STRUCTURES Towers & Site Fabrications

Taking Amateur Radio to New Heights

Free standing towers to 180 feet and complete antenna systems!

Packages Include:

- PE Stamped certifications for your state
- Tower, Tower base and accessories
- Rotators, plates, thrust bearings, certified masts
- Lightning arrestors and grounding products
- Antennas, baluns
- Antenna switches and phasing systems
- Professional delivery at discounted prices

Call us to discuss your needs and we can engineer an economical, safe, and effective system for you.

Array Solutions

www.arraysolutions.com

Sunnyvale, Texas USA
Phone 214-954-7140
sales@arraysolutions.com
Fax 214-954-7142

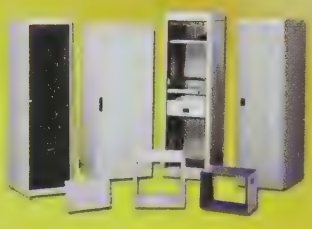
Array Solutions products are in use at top DX and Contest stations worldwide as well as commercial and governmental installations. We provide RF solutions to the DoD, FEMA, Emcomm, UN, WFO, FAA and the State Dept. for products and installation of antennas systems, antenna selection, tuning, switching and grounding. We also offer RF engineering and PE consulting services.

HAMMOND MANUFACTURING™

Visit our web site for technical data, drawings, PDF catalogs and a list of stocking distributors.

Audio, B+, Filament & Power Transformers & Inductors

Racks, Rack Cabinets & Accessories



Plastic, Die-cast & Metal Enclosures Aluminum & Steel Chassis

www.hammondmfg.com

U.S.
Tel:(716) 630-7030 Fax:(716) 630-7042

Canada
Tel:(519) 822-2960 Fax:(519) 822-0715

ARRL Audio News

A weekly summary of Amateur Radio news highlights in a fifteen-minute podcast, updated every Friday.

Enjoy ARRL Audio News anywhere: on your smart phone or tablet, your local repeater, iTunes, or stream it on the go!

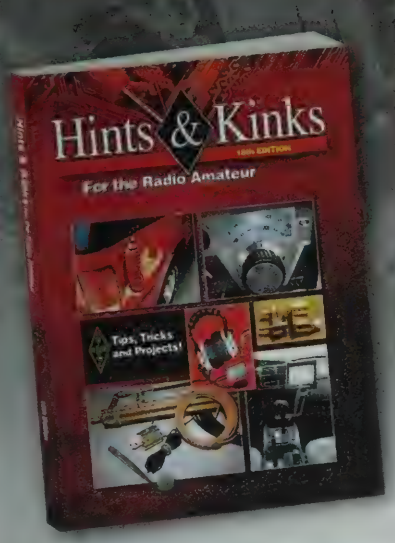
www.arrl.org/arrl-audio-news

ARRL The national association for AMATEUR RADIO

SHOP DIRECT *or call for a dealer near you.*
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 2/2014

Tips, Tricks & Projects



Hints & Kinks
for the Radio Amateur
18th Edition

Ideas for Any Shack!

QST's monthly ***Hints & Kinks*** column is one of the most popular sections of the magazine—and it's easy to see why. If you're in the mood for an evening or weekend project, you'll find it in ***Hints & Kinks***

This brand new edition gathers the best projects and problem-solving techniques spanning 8 years, from 2004 through 2011. It's more than 170 pages of practical information you can use every day!

Includes:

- Equipment Tips and Mods
- Batteries and Other Power Sources
- Mobile and Portable Stations
- Software and Computers
- Troubleshooting/Test Gear
- Restoration
- Construction/Maintenance
- Antenna Systems
- Operating
- Around the Shack
- Interference (RFI/EMI)

ARRL Order No. 5200
Special ARRL Member Price!
Only $19.95* (regular $22.95)
*plus shipping and handling

ARRL *The national association for AMATEUR RADIO®*
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 1/2015

EXPERT LINEARS America LLC

Authorized Distributor for SPE Linear Amplifiers

UP-TO-DATE, FULLY AUTOMATIC SOLID STATE LINEAR POWER AMPLIFIERS

1.3K-FA 2K-FA 1K-FA

Includes Power Supply & Automatic Antenna Tuner

Fully Remoteable! Can be placed in remote locations.

The CPUs intelligently protect and control the linears plus produce warning & alarm messages.

Look for us at most **TEXAS HAMFESTS**

Expert Linears America, LLC Offers
SALES & EXPERT SERVICE

On-site Factory-trained Service ★ Authorized Distributor for SPE Linears
Typical 48-hour Turnaround ★ Ask about Custom Dust Covers
Over 50 years RF Experience ★ Five-Star Reputation for Quality and Service
★ BEST VALUE at Competitive Price ★

EXPERT LINEARS AMERICA, LLC
PO Box 1224, Magnolia,TX 77355 | 281-259-7877 | 281-725-2113
Contact: Bob Hardie W5UQ | Bob@ExpertLinears.com
ExpertLinears.com

Tigertronics *SignaLink™ USB*

When it comes to sound card interfaces, nothing beats the ***SignaLink USB's*** combination of performance, value, and ease of use! Whether you're new to Digital operation, or an experienced user, the ***SignaLink USB's*** built-in sound card, front panel controls, and simplified installation will get the job done right the first time—and without breaking the bank! The ***SignaLink USB*** supports virtually all sound card digital and voice modes, and works with virtually all radios. It is fully assembled (**made in the USA!**) and comes complete with printed manual, software, and all cables. Visit our website today and see what all the buzz is about!

PSK31 JT65-HF SSTV RTTY EMCOMM CW + more!

Only $119.95 + s/h

Radio cables are now available for many Baofeng, Wouxun, Yaesu, and Kenwood HTs!

Tigertronics Grants Pass, Oregon

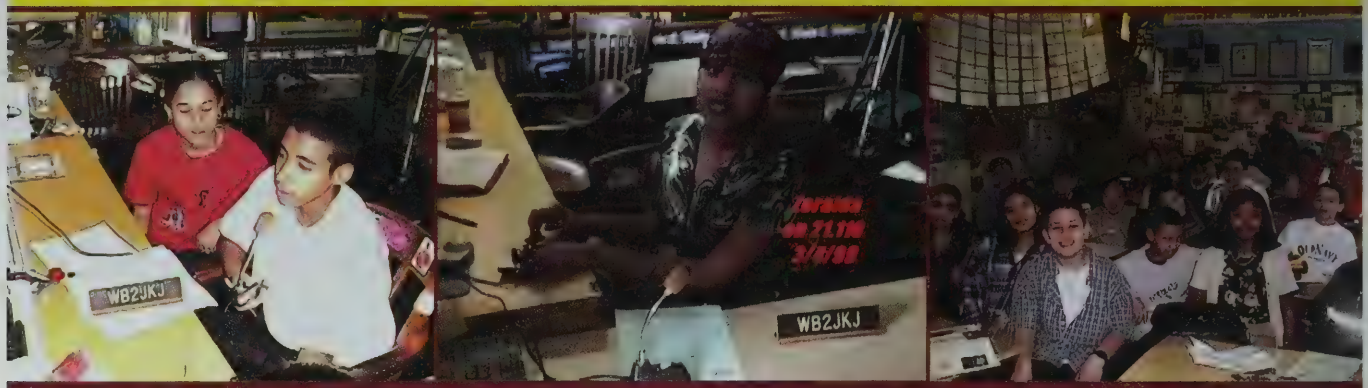
Order Toll Free!
800-822-9722
541-474-6700

www.tigertronics.com

Tigertronics 154 Hillview Drive Grants Pass, Oregon 97527

The Radio Club of Junior High School 22

Bringing Communication to Education Since 1980



DONATE YOUR RADIO

Radios You Can Write Off - Kids You Can't

- Turn your excess Ham Radios and related items into a tax break for you and a learning tool for kids.
- Donate radios or related gear to an IRS approved 501(c)(3) charity. Get the tax credit and help a worthy cause.
- Equipment picked up anywhere or shipping arranged.

RC OF JHS 22 NYC
PO Box 1052
New York NY 10002

Call Now 516-674-4072
email: crew@wb2jkj.org www.wb2jkj.org

WB2JKJ

ALPHA TUBES

World Class Amplifiers, World Class Tubes.

- World Class design
- World Class reliability
- 2 year Warranty on all products
- All current production (no NOS)
- Individually tested.

3CX1500A7
$675.00

4CX1500B
$505.00

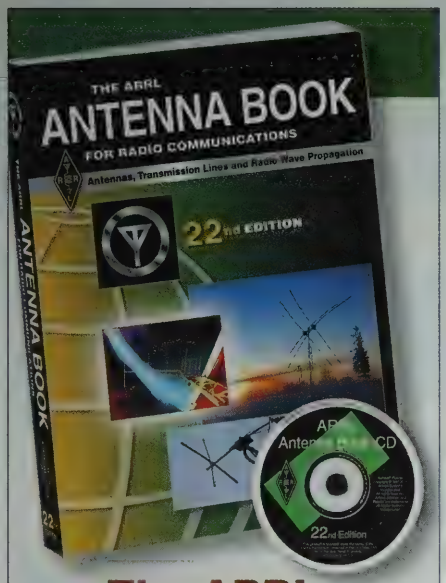
811A
$16.95

3CX800A7LG
(low grid current)
$400.00

3-500ZG

24 hour R.F. Aged
single $135.00
mp-2 $278.00
mp-3 $417.00
mp-4 $556.00

Bigger? Smaller? Different?
for a full list of tubes and prices visit:
www.rfconcepts.com/tubes
303-473-9232



The ARRL Antenna Book

Build One Antenna, and You'll Quickly Find Yourself Planning the Next!

22nd Edition

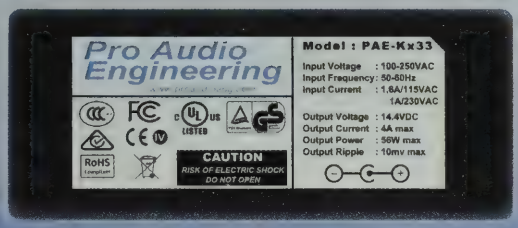
The *ARRL Antenna Book* includes everything for complete antenna systems—from planning, to design and construction. You'll find antennas for nearly any frequency range and operating application: from the HF low bands through VHF, UHF and microwave; fixed station, portable, mobile, satellite and more.

- Antenna Fundamentals
- Dipoles and Monopoles
- The Effects of Ground
- Loop Antennas
- Multielement Arrays
- Log-Periodic Dipole Arrays
- Antenna Modeling
- Single-Band MF and HF Antennas
- Multiband HF Antennas
- HF Yagi and Quad Antennas
- Long-Wire and Traveling-Wave Antennas
- HF Antenna System Design
- VHF and UHF Antenna Systems
- VHF and UHF Mobile Antennas
- Antennas for Space Communications
- Special Applications & Portable Antennas
- Stealth and Limited Space Antennas
- Mobile and Maritime HF Antennas
- Receiving and Direction-Finding Antennas
- Transmission Lines
- Antenna Materials and Construction
- Building Antenna Systems and Towers
- Antenna System Troubleshooting

Softcover Book with CD-ROM
ARRL Order No. 6948
Only $49.95*
*plus shipping and handling

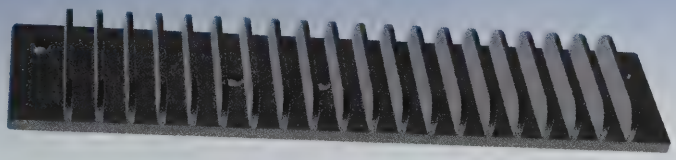
ARRL The national association for AMATEUR RADIO
SHOP DIRECT or call for a dealer near you
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

Kx33 14V 4A Power Supply



Pro Audio Engineering

QRP accessories and more - www.proaudioeng.com



Kx31 Elecraft KX3 Heatsink

W4TMU RADIO WORKS™ LLC
CAROLINA WINDOM®
The "real" CAROLINA WINDOM® available at radioworks.com

TENSIONER™
ANTENNA TREE SWAY PROTECTION

Stealthy tree top shock absorber tames tree sway, controls tension, sag. See one in action at...

www.antennatensioner.com

N4PY SOFTWARE

www.n4py.com

Control software for your Icom, Elecraft, Flex, Yaesu, Kenwood, and Ten-Tec radio.
Add a Panadapter to your existing radio. Full remote client/server operation capabilities.
Full Woodbox radio Tmate2 support.

– Customer Service Second to None –

WAVECOM© HF/VHF/UHF Decoder
Professional decoder, more than 250 Protocols/ Decoder/ Demodulators, Analyzer, Classifier, Code Check, etc.. W-CODE, W-PCIe/PCI-LAN, W-Classifier, etc.

COMPUTER INT'L, St. Johns, MI 48879
www.wavecomusa.com

Failed the Exam? Can't upgade?

*Use a **more effective** study method and achieve your dream!*

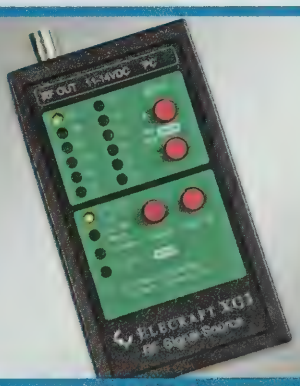
HamTestOnline
The software that knows you

Top-rated on eHam.net, with more 5-star user reviews than all other study methods *combined!*

100% guaranteed – you pass the exam or get a full refund!

Try our free trial!

www.hamtestonline.com



XG3 HF-VHF Synthesized RF Source!

The XG3 is a programmable, 160-2 m hand-held RF signal source with four calibrated output levels. It's ideal for RX calibration, sensitivity tests, signal tracing, and as a VFO for home-brew projects. It's also useful outdoors—for antenna evaluation, field strength measurements, micro-power beacons, etc.

- 1.5 - 200 Mhz (1400 Mhz w/harmonics)
- 12 programmable memories
- Sweep Functions, CW/RTTY beacons
- Computer controllable

MasterCard VISA

ELECRAFT®

Elecraft is a registered trademark of Elecraft, Inc.
www.elecraft.com • (831) 763-4211
sales@elecraft.com
P.O. Box 69, Aptos, CA 95001-0069

Hamvention® 2015

Homebrew Radio

Is this your year to take the trip to Dayton?
We are gearing up for the biggest Hamvention yet.

Ticket Prices: $20 in advance, $25 at the door.
General Inquiry: Dayton Hamvention®
937.276.6930 P.O. Box 964 Dayton, OH 45401

www.hamvention.org

Buy your Tickets, Flea Market, and Inside Exhibit spaces online.
OR Send SASE with a check made out to Dayton Hamvention
To: Hamvention Tickets, P.O. Box 1446, Dayton, OH 45401

May 15-17, 2015 Hara Arena, Dayton, Ohio

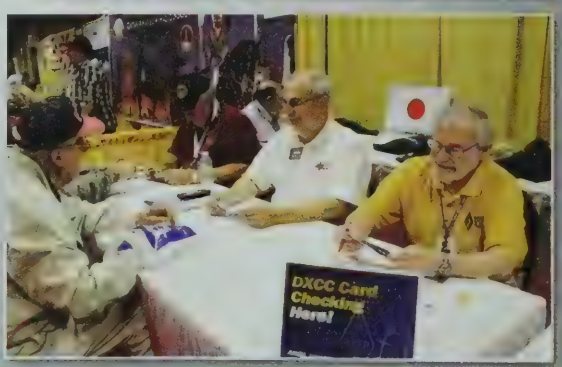
100 Years of QST
ARRL at DAYTON 2015

ARRL EXPO 2015

Your Hamvention® admission includes entry to ARRL EXPO

Program Highlights

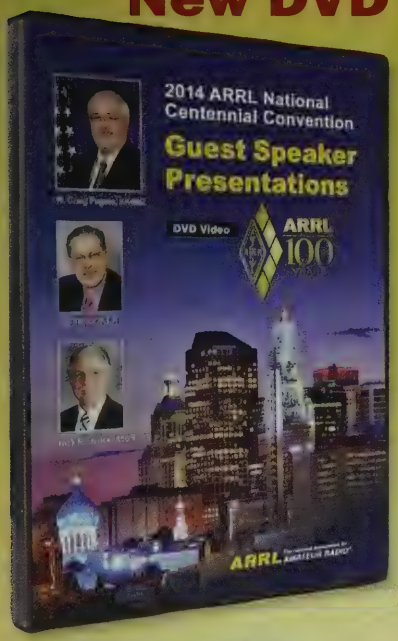
- Special Exhibits and Guests
- ARRL Bookstore
- Presentations
- DXCC Card Checking
- ARRL Youth Activities – friends, fun and food!
- Join or renew with ARRL – and receive a FREE GIFT



www.arrl.org/expo

ARRL The national association for AMATEUR RADIO®

New DVD



2014 ARRL National Centennial Convention

Guest Speaker Presentations DVD Video

On the brink of a Second Century

The ARRL National Centennial Convention was held July 17-19, 2014 in Hartford, Connecticut—a once-in-a-lifetime celebration of Amateur Radio's proud past and promising future. Over 3,300 members and friends attended, enjoying more than 60 programs and seminars, over 100 exhibits, and tours of nearby ARRL Headquarters and the Maxim Memorial Station, W1AW. This DVD includes convention presentations from three special guest speakers.

Rick Roderick, K5UR, ARRL First Vice President
with introduction from Brian Mileshosky, N5ZGT, ARRL Rocky Mountain Division Director (July 17, 2014).
Run time: 22:49 minutes

W. Craig Fugate, KK4INZ, Federal Emergency Management Agency (FEMA) Administrator
with introduction from Mike Lisenco, N2YBB, ARRL Hudson Division Director (July 18, 2014).
Run time: 46:45 minutes

Joe Taylor, K1JT, Nobel Laureate - Physics
"Gazing into the Future—DXing with Weak Signals and Beyond"
with Introduction from Rick Niswander, K7GM, ARRL Treasurer (July 19, 2014).
Run time: 41:09 minutes

DVD Video
ARRL Order No. 1241
Only $12.95*
*plus shipping and handling

ARRL *The national association for AMATEUR RADIO®*
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 2/2015

M² ANTENNA SYSTEMS, INC.

SPRING TIME IS ANTENNA TIME
Let us help you with your spring antenna projects.

WORLD CLASS PRODUCTS

Look towards the sky with the NEW LEO-Pack

The new LEO-Pack is the latest small satellite system from M2 Antenna Systems, Inc. The 2MCP8A is a circularly polarized antenna optimized for the 2M satellite band. The 436CP16 has been designed for an optimum match and gain at the 70CM satellite band. These are together with a cross boom and mounting hardware. Ideal for a great Low Earth Orbit (LEO) communications system. Add a small azimuth rotator and set these at 45-55° elevation and you are ready to have fun with a small home or portable system.

*Antennas and cross boom also available separately.

The KT31WARC offers great flexibility in size and performance. A simple two band dipole for 12M & 17M. It spans just 13 feet. Adding 20M or 30M is offered as an option using a coil assembly.

M² offers a complete line of top quality amateur, commercial and military grade antennas, positioners and accessories.

We produce the finest off-the-shelf and custom radio frequency products available anywhere.

For high frequency, VHF, UHF and microwave, we are your source for high performance RF needs.

M² also offers a diverse range of heavy duty, high accuracy antenna positioning systems.

Whether your communication requirements are across town, around the world or beyond, M² has World Class Products to suit your application.

Online store @ http://store.fastcommerce.com/m2inc/shop.cgi

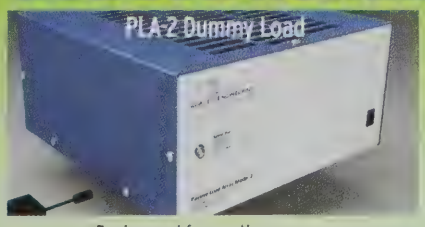
M² products are proudly "Made in the USA"

4402 N. Selland Ave.
Fresno, CA 93722
Phone (559) 432-8873
sales@m2inc.com
http://www.m2inc.com

*Prices subject to change without notice.

ANTENNAS POSITIONERS ACCESSORIES

Robust. Reliable. Rock Solid.



Engineered for continuous use
Dry - no oil or coolant required

Four external coupler ports
Power range of 10mW to 2KW

APPLIED ENGINEERING SCIENCE, INC.

See product reviews at www.aes-rf.com
303.920.8180 to order

AES, Inc. accepts MasterCard, Visa, Discover, American Express and Checks

bhi

Don't put up with noise and interference..
..Get a bhi DSP Noise canceling product!

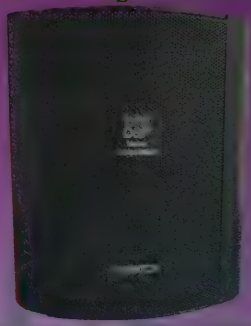
HEAR IT Speaker
- *"Quick Adjust"* DSP control
- 8 DSP filter levels 9 to 35dB
- 2.7W Amplified DSP speaker
- 3.5mm mono headphone socket
- On/off audio bypass switch
- 12 to 24V DC (500mA)

DSPKR

DSPKR -10 watt DSP speaker- 7 filter levels 9 to 24dB - Sleep mode - Filter store function - Volume control - Input overload LED - 3.5mm Mono headphone socket - 10 to 16V DC (2A) - Supplied with integral 3.5mm mono audio plug lead, user manual & fused DC power lead.

Read the great review of the bhi DESKTOP speaker in this issue!

DESKTOP DSP Speaker



10 watt **DESKTOP** DSP speaker - 4" bass driver and 1" tweeter - Digital rotary volume and filter level controls - Separate stereo line-in and speaker level inputs - Headphone socket - Audio overload feature - Sleep mode - Noise reduction 9 to 35dB - 12V DC to 18V DC power (2.5A peak) - Weight 3.6lb, dims 8"(h) x 6"(d) x 6.3"(w) - Supplied with fused DC power lead, 3.5mm mono audio plug lead & user manual.

HEAR IT In-Line

HEAR IT In-Line - Amplified DSP In line module - Use with a speaker or phones - 8 filter levels 9 to 35dB - Separate input level and volume controls - 3 Watts audio - Supplied with 3.5mm audio plug lead, user manual & fused DC power lead.

Take a look at the new bhi website www.bhi-ltd.com

bhi Available from:

W4RT Electronics
fax: 256 880 3866
www.w4rt.com
info@w4rt.com

E & O.E.

Products designed in the UK by bhi Ltd
www.bhi-ltd.com

Available as "HEAR IT" from GAP:
GAP Antenna Products Inc.
99 N.Willow St. Fellsmere, FL 32948
Tel: (772) 571 9922 Fax: (772)5719988
www.gapantenna.com

GAP

Air Boss Antenna Launcher
www.kr4lourboss.com
See Video
For when you want your antenna on top
$59.95
boss@kr4lourboss.com

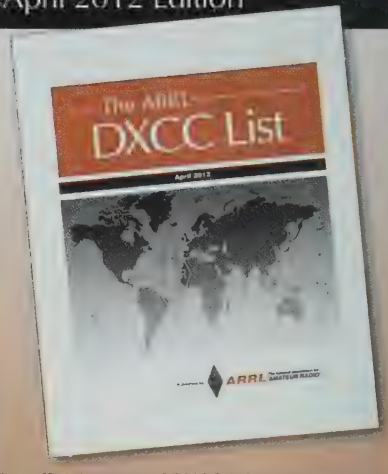
DTMF decoder board with eight relays

Remote control eight devices via radio audio. Password protection against unauthorized entry. Unique board ID. Comes assembled with relays. 4.5" x 2.5".

Intuitive Circuits, LLC
Voice: (248) 588-4400
http://www.icircuits.com

DTMF-8 $119.00
Visa • MC • Prepayment

The ARRL DXCC List
April 2012 Edition



The official source of DXCC information. Record the DXCC Entities you've worked and QSLed! This edition includes a complete listing of DX Century Club rules including the latest changes and clarifications, plus the current entity list. Also includes a prefix cross-reference, the list of international call sign series, and much more. A "must have" for every DXer!

ARRL Order No. 3862
Only $5.95*
*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)
OST 10/2012

MISSING SOMETHING?
Without the Right Antenna and Installation You May Never Know

CHALLENGER DX
2m, 6m, 10m, 12m, 15m, 20m, 40m, and 80m.
31' tall, 21 pounds
supplied with drop in ground mount.

TITAN DX
10m, 12m, 15m, 17m, 20m, 30m, 40m, and 80m.
25' tall, 25 pounds
mounts to 1-1/4" pipe.

EAGLE DX
10m, 12m, 15m, 17m, 20m and 40m.
21' tall, 19 pounds
mounts to 1-1/4" pipe.

VOYAGER DX
20m, 40m, 80m, and 160m
45' tall, 49 pounds
supplied with hinged base.

All GAP antennas DO NOT require a tuner or radials and will handle the legal limit except for the lowest band on each.

FIND OUT WHAT YOU'VE BEEN MISSING
BY ORDERING YOURS TODAY

GAP Antenna Products, Inc.
99 North Willow St. ▪ Fellsmere, FL 32948
Tel. 772-571-9922 ▪ www.gapantenna.com ▪ email: contact@gapantenna.com

hy-gain® Rotators

. . . the first choice of hams around the world!

HAM-IV

The most popular rotator in the world!

For medium communications arrays up to 15 square feet wind load area.*Has* 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-IV **$649.95**

HAM-VI **$749.95** with DCU-2

HAM-VII **$799.95** *with DCU-3*

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER SERIES II

For large medium antenna arrays up to 20 sq. ft. wind load. Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $109.95.** Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2X **$799.95**

T-2XD2 **$899.95** with DCU-2

T-2XD3 **$949.95** with DCU-3

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II **$449.95**

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

hy-gain Programmable DCU-3 Digital Rotator Controller

New!

DCU-3 **$449.95**

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins *(great for older rotators with "sticky" brakes)* then turns off your motor before reaching its final heading. Your antenna *gently* coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for *full* manual control and fine tuning.

Bright blue LCD shows current, dialed-in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order **DCU-3X** for 220 VAC.

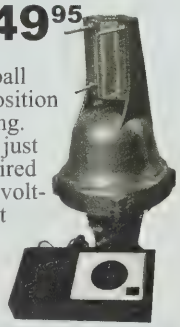
DCU-2 Digital Rotator Controller

$399.95. Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

AR-40

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area. Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 **$349.95**



AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

Replace your *YAESU* Rotator Controller

Hy-gain YRC-1 gives you more features and a much more robust controller that is far less prone to lightning damage. Costs less than repairing your original Yaesu controller!

Easy-to-use -- dial in your beam heading and tap *GOTO* button. *Exclusive* 180 degree *AutoReversal*™ for fast longpath operation.

Has all features of DCU-2. Bright blue LCD shows current, dialed-in and computer controlled beam headings and your call. USB port for computer control. Extra heavy-duty AC power supply.

Variable DC motor speed for minimizing damaging antenna overshoot and fast operation. Intuitive menu for calibrating, offsetting, or changing parameters. Field upgradeable firmware. Use with Yaesu G-800/1000/2800/G450/650. For AC or DC motors.

New! YRC-1 **$329.95**

www.hy-gain.com

Nearest Dealer, Free catalog, To Order . . .

Voice: 662-323-9538 **Fax:** 662-323-6551

hy-gain®

Antennas, Rotators & Towers

308 Industrial Park Road,Starkville, MS 39759, USA

Prices/specs subject to change without notice or obligation ©2014 Hy-Gain

Ham Radio Deluxe

Amateur Radio Software Suite

Your complete ham shack integration solution

You get:

- Lifetime license for Ham Radio Deluxe
- Five integrated modules to supercharge your operating experience
- One year of technical support

All for just $99.95!

Still have questions? Download it today and try it free for 30 days. HRD is available for download exclusively on our website.

Visit http://ham-radio-deluxe.com.

Ham Radio Deluxe is available from your favorite Amateur Radio retailer, or **order direct** from us today!

Ham Radio Deluxe

Rig Control - Logbook - Digital Master - Satellites - Rotor Control

http://www.ham-radio-deluxe.com - (813) 434-4650

AMERITRON® *automatically* tunes your screwdriver antenna as you tune your transceiver!

Super accurate tuning . . . Ultra-fast . . . Extremely Reliable . . . 88 memories . . . StallProtector™ . . . Fully RFI protected . . . Easy-to-use . . . Compact . . . Works with most screwdriver antennas and Icom, Kenwood, Yaesu, Elecraft transceivers . . .

SDC-104 (I, K, Y, E)

$159.95

Suggested Retail

New!

Call your dealer for your best price!

Ameritron* AutomaticTune™ *mode automatically tunes your screwdriver antenna for lowest SWR as you tune your transceiver!

You get super accurate, ultra-fast and extremely reliable tuning with 88 programmable memories.

You also get a *Stationary Tune*™ mode that lets you tune your transceiver *without* your antenna constantly moving -- then touch TUNE when you're ready.

Or you can use *ManualTune*™ mode by simply touching up/down buttons until you reach your desired frequency.

Precision four digit LED readout gives you antenna position, motor current and transceiver frequency -- it's so bright you can even read it in direct sunlight.

Its super compact, ergonomic design is so intuitive to use you'll never need the instruction book! 3⅝Wx3½H x1⅝D inches fits anywhere.

Fully RFI protected with RF chokes and bypass capacitors on incoming and outgoing wires and other sensitive points. All aluminum RF-tight cabinet. Completely eliminates troublesome RFI problems.

Ameritron's exclusive *StallProtector*™ prevents your expensive motor from burning out. It auto-detects motor stall and shuts off power to the motor completely. Current limit is adjustable 100 mA to 4.9A in 100 mA increments.

Menu allows change of motor direction without physically reversing wires.

Works with single/dual magnetic sensor screwdriver antennas. Includes interface cable for your transceiver, power, motor control and sensor wires. Specify Icom, Kenwood, Yaesu or Elecraft. Additional cable, $24.95 each.

SDC-102, $129.95

Program in ten favorite frequencies and simply push a button to send your antenna there! Up/down buttons easily tune to any frequency. Super bright *read-in-sunlight* LED digits tell exact antenna position. Easy-to-use. AutoPark™, StallProtector™.

SDC-100B, $109.95

Up/down buttons let you manually tune your screwdriver antenna quickly! Super bright *read-in-sunlight* LED digits tell exact antenna position with -999 to +999 digital count range. On/off switch. Reset switch lets you easily recalibrate.

AMERITRON® Mobile Solid State Amplifier

ALS-500M

$949

Suggested Retail

Call your dealer for your best price!

500 Watts PEP SSB/400 Watts CW output! Covers 1.5-22 MHz (10/12 Meters with MOD-10M, $29.95, requires FCC license).

Turn on and operate -- no warm-up, no tuning, instant bandswitching. 9Wx3½Hx15D", 7 lbs.

Virtually indestructible! *Load Fault Protection* eliminates damage due to operator error, antenna hitting branches, trucks passing by. *Thermal Overload Protection* disables/bypasses amplifier if temperature is excessive. Automatically resets.

60-70 Watts in gives full output. On/Off switch bypasses amplifier for barefoot operation. Extremely quiet fan turns on as needed. Excellent harmonic suppression, push-pull output, DC current meter. Use 13.8 VDC/80 Amps.

ALS-500RC, $49.95. Remote head gives full manual, remote control of ALS-500M.

ARI-500, $119.95. Lets your transceiver auto bandswitch your ALS-500M amplifier.

SPS-75MV, $259.95. 110/220 VAC input, 75A@13.8 VDC out. Switching power supply lets you operate ALS-500M at home.

AWM-35B *Precision* Mobile SWR/Wattmeter

AWM-35B/BH

$159.95

Suggested Retail

Just 1⅝" thick -- easily mounts on your dashboard for easy viewing. Remote sensor with 25' thin, flexible cable lets you place the sensor and coax *out-of-the-way*. Handles full 1500 Watts, 1.8-60 MHz. LED lighted Cross-Needle SWR/Watt-meter. Read *true peak* or average power in two power ranges. Has high SWR LED. Wattmeter is 5Wx3¼H x1⅝D inches. Remote is 3½Wx 2¾H x2¾D inches. Use 9V battery or 12 VDC.

AWM-35B, $159.95 has 300 Watt low, 3 kW high meter scale.

AWM-35BH, $159.95 has 100 Watt low, 1000 W high meter scale.

Call your dealer for your best price!

Free Catalog: 800-647-1800

AMERITRON®

. . . the world's high power leader!

116 Willow Road, Starkville, MS 39759

TECH (662) 323-8211 • **FAX** (662) 323-9810

8 a.m. - 4:30 p.m. CST Monday - Friday

For power amplifier components call (662) 323-8211

www.ameritron.com

Prices and specifications subject to change without notice. ™ 2015 Ameritron

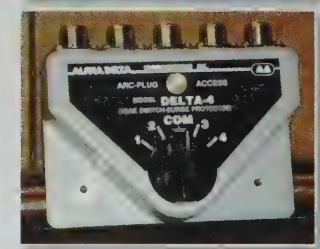
AMERITRON . . . the World's High Power Leader!

ALPHA DELTA COMMUNICATIONS, INC. AA

32 YEARS Superior Customer Service Continuous Product Innovation

Industry Leading Surge Protected Coax Antenna Switches. Low Loss with excellent Co-Channel Isolation. Models DELTA-2B/N and DELTA-4B/N have been granted NSN numbers by the Defense Logistics Agency (DLA) for use in ALL U.S. and NATO applications, worldwide. Cage Code 389A5. Made in the U.S. in our ISO-9001 certified production facility.

The Alpha Delta **Model ASC Antenna Selector Console** desk top coax switch series brings a new level of versatility and convenience to your station operation. This series retains all the features and specifications of the precision 4 position DELTA-4B series (see WEB site for DELTA-4B specs, pictures and info), including ARC-PLUG™ module surge protection, in a desk top console that will sit right next to your equipment on your desk without having to be secured or bolted down. "Non-slip" feet attached for best stability.



The console features a powder coated steel housing and a solid brass ground buss, with #10 wire attachment hardware, across the rear of the housing providing a common ground point for all station equipment and accessories.

- Model ASC-4B Antenna Selector Console (4 position, UHF type, thru 500 MHz) .....$149.95 ea.
- Model ASC-4B/N Antenna Selector Console (4 position, N type, thru 1.3 GHz).....$159.95 ea.

Our standard surge protected coax switch line (see WEB site for details):

- Model DELTA-2B, 2 position, UHF connectors, 500 MHz .....$59.95 ea.
- Model DELTA-2B/N, 2 position, N connectors, 1.3 GHz.....$75.95 ea.
- Model DELTA-4B, 4 position, UHF connectors, 500 MHz .....$89.95 ea.
- Model DELTA-4B/N, 4 position, N connectors, 1.3 GHz.....$99.95 ea.

All prices plus shipping/handling. 888-302-8777. Also available from Alpha Delta dealers.

www.alphadeltacom.com

for product technical details, installation requirements, pricing, dealers and contact information.

Select Quality, Specify Mosley...

Mosley... a better antenna!

For a Catalog Call 800-325-4016

www.mosley-electronics.com

Special Advertising Section
QST March 2015

Visit us at www.arrl.org

ARRL The national association for AMATEUR RADIO®

Special Advertising Section
QST March 2015

ANTENNA TIME

Products & Services

Advertisers

AeroStream – CommRadio Division
www.commradio.com – Page 135

Alpha Node Hub
www.alphanodehub.com – Page 133

Balun Designs LLC
www.balundesigns.com – Page 133

Buddipole Antennas
www.buddipole.com – Page 131

EZ Hang
www.ezhang.com – Page 133

Force 12/InnovAntennas
www.Force12Inc.com – Page 131

Green Heron Engineering
www.greenheronengineering.com – Page 135

Kuhne electronic
www.kuhne-electronic.de – Page 135

Mosley Electronics
www.mosley-electronics.com – Page 131, 133

NCG Company
www.natcommgroup.com – Page 132

Portable Rotation
www.portablerotation.com – Page 133

RMItaly.US
www.rmitaly.us – Page 130

Telewave, Inc.
www.telewave.com – Page 130

Timewave Technology, Inc.
www.timewave.com – Page 136

Top Ten Devices, Inc.
www.qth.com/topten – Page 133

American Radio Relay League
225 Main Street
Newington, Connecticut 06111-1494 USA

www.arrl.org

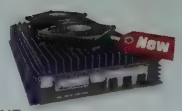
100 Years of QST 1915-2015

HF Linear Amplifier are designed specifically for the US Market

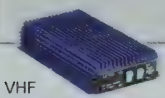
HF
KL 7505V Linear Amplifier
Freq. Range: (28-30MHz)
Class AB push-pull
Power Supply 30A
Input: 10 Watts
Output: 240Watts
Max Gain: 15 db
All Modes: AM,FM,SSB and CW
Size: 6.7" x 11.61" x 2.4"

HF
KL 7405V 10M Linear Amplifier
Freq. Range: (28-30MHz)
Class AB push-pull
Power Supply: 18A
Input: 5 Watts
Output: 120 watts
Max Gain: 15 db
All Modes: AM,FM,SSB and CW
Size: 6.7" x 8.3" x 2.4"

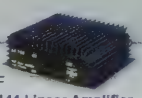
HF
HLA 305V Linear Amplifier
Freq. Range: (1.8-26MHz), (28-30MHz)
Ideal for QRP Radio, Class AB push-pull
Large Heatsink, Powerful Processor
Overdrive Protection, Improved Noise Filtering
Power Supply: 45A
Input: 1-10 W typ. (15W Max)
Output: P1db 200W CW ± 1db typ
Gain: 13.5 ± 1db P1db
6 Band Filter and LCD for Amplifier Status
Size: 9.44" x 2.75"x 17.7"



VHF
LA 250V Linear Amplifier
Freq. Range: (140-150MHz)
Large Heatsink, LCD Display,
Overdrive Protection
Power Supply: 30A
Input: 1-15W
Output: 200 Watts
Transistor: 4x Mitsubishi RD70HVF1
Size: 9.44" x 2.75" x 16.5"



VHF
LA 145 Linear Amplifier
Freq. Range: (135-175MHz)
Wide band, Compact, Perfect for 2M HT
Input: 0.5W to 4W max.
Output: 85W max
All Modes: FM, SSB, and CW
Power Supply: 12-14Vdc
Size: 4.3" x 8.8" x 1.4"



VHF
LA 144 Linear Amplifier
Freq. Range: (135-175MHz)
Wide band, Compact, Perfect for 2M HT
Input: 0.5W to 4W max.
Output: 70W max
All Modes: FM, SSB and CW
Power Supply: 12-14Vdc
Size: 4.7" x 4.9" x 1.57"

LIMITED TIME INTRODUCTORY SPECIAL!

AUTHORIZED DEALER
www.rmitaly.us

RM ITALY
A Passion for Communication

Tel: 408.490.0680 Email: rmitaly.us@gmail.com

POCKET REF

By Thomas J. Glover

All the information you'll ever need is right at your fingertips!

This handy pocket-sized guide features tables, charts, drawings, lists, and formulas especially useful for radio amateurs, contractors, students, travelers, electronics hobbyists, craftspeople, and engineers and technicians in virtually every field. Embossed with ARRL's logo and logotype—making this a particularly special edition.

ARRL Order No. 1148
Only $12.95*
*plus shipping and handling

ARRL The national association for AMATEUR RADIO™
SHOP DIRECT *or call for a dealer near you.*
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)
QST 5/2010

WATTMETERS FOR AMATEUR RADIO.

Model 44L1P (2-200 MHz)
Model 44AP (20-1000 MHz)

FEATURES:

- Requires no elements or "slugs"
- No band switching
- Measures 1 to 500 watts
- 5 power ranges
- 5 watt full scale range
- Measures forward & reflected power
- –40 dB RF sampling port
- Shock-mounted meter
- Low temperature operation
- Quick-change connectors

PROUDLY MADE IN AMERICA

Telewave offers discounts to amateur operators and clubs with valid callsign.

TELEWAVE, INC.®

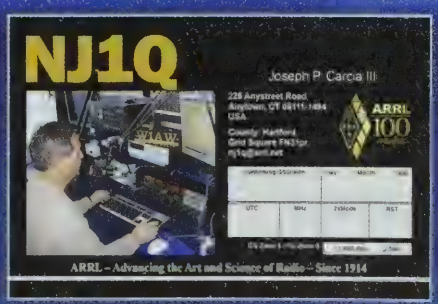
1-800-331-3396 | www.telewave.com

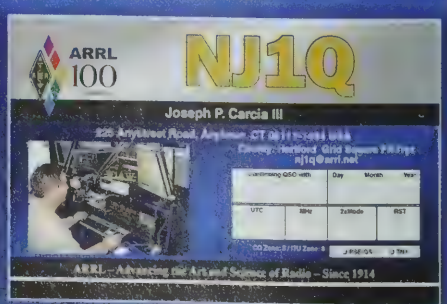
ISO 9001 CERTIFIED

Coming Soon...
Dayton Hamvention®

100 Years of QST
ARRL at DAYTON 2015

ARRL Centennial QSL Cards





Select from 3 specially designed QSL cards celebrating the ARRL Centennial.
Order 100, 250, 500, 1000 or more. As low as 15¢ / card per 1000.
Begin designing your custom ARRL QSL Cards. Enjoy!

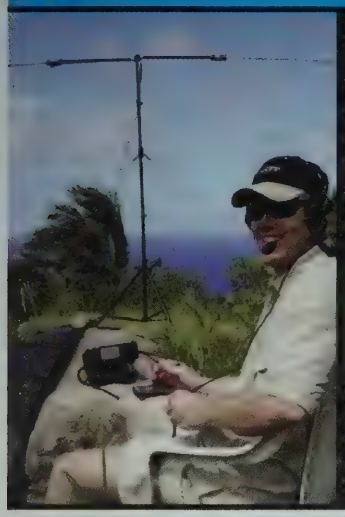
ARRL Centennial Designs

ARRL The national association for AMATEUR RADIO®
www.arrl.org/shop

Customize and order your QSL cards online
www.arrl.org/centennial

BUDDIPOLE

Made in USA



ANTENNAS & MORE

From beaches to mountaintops, condos to RV parks and everywhere in between, the Buddipole line of portable HF antennas and accessories is ideal for both novice and expert operators alike.

We manufacture all of our antennas using custom CNC parts and injection molds with carefully selected materials.

We also manufacture A123 Nanophosphate battery packs for all portable radios. These power packs provide unparalleled performance in the field. See our website for more details.

BUDDIPOLE FEATURES

- Multi-band design works 9 bands (40 meters thru 2 meters) with one set of adjustable coils!
- Rated from QRP to 250 watts PEP
- Modular Design – create dozens of different antennas with interchangeable parts
- Rotatable/Directional
- Lightweight, rugged components
- Rotating Arm Kit allows users to instantly change antenna configurations
- Used by Emergency Services Groups throughout the world

WHAT IS THE BUDDIPOLE?

The Buddipole™ Portable Dipole fits in your travel bag and assembles in minutes. The Buddipole is more than an antenna, it's a versatile system for launching your signal. Optimized for transmit power and proven for DX work, the Buddipole is the secret weapon used by HF portable operators all over the world.

Secure online ordering at:
www.buddipole.com

See our videos
www.youtube.com/buddipole

3028 SE 59th Court, Suite 600
Hillsboro, OR 97123

tel: (503) 591 8001
fax: (503) 214 6802

info@buddipole.com

ARRL Visa Signature® Card

www.arrl.org/visa

ARRL Members: Support ARRL and earn fast rewards!

A portion of every card purchase will be contributed automatically to ARRL. So you can make a difference every single day.

ARE YOU **CRAMPED** FOR SPACE?...

No need to wish upon a star...
when you can put a ***Mosley MINI*** under the stars!

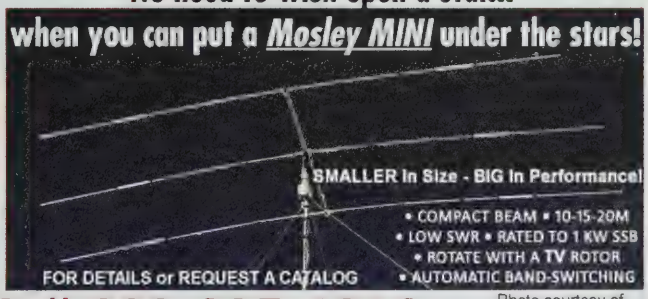

SMALLER In Size - BIG In Performance!
• COMPACT BEAM • 10-15-20M
• LOW SWR • RATED TO 1 KW SSB
• ROTATE WITH A TV ROTOR
• AUTOMATIC BAND-SWITCHING
FOR DETAILS or REQUEST A CATALOG

Photo courtesy of ARS 5B4ALJ

Call 800-325-4016

Mosley... a better antenna!

www.mosley-electronics.com

FORCE 12 **Be a Force on 40!** InnoAntennas.us Performance through Innovation

8 Bands, Small Footprint, BIG Signal!

Force 12's new Delta-C technology uses highly efficient Cap Loading on 30 meters plus 3rd-gen Delta Coils on 40 for elements under 40 feet tip-to-tip.

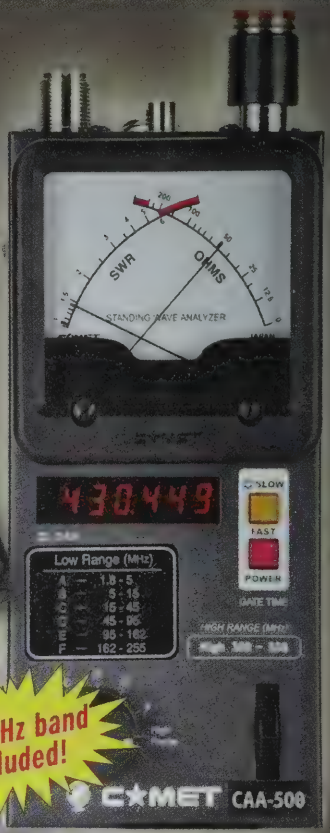
- XR- Series Multi-Monoband Yagis now available in "Plus 40" versions
- New Magnum 340 FT (Flame Thrower) ***FULL-SIZE*** 40m Yagi uses G0KSC OP-DES design for full-band coverage
- Add Delta-C 130 rotary dipole for great 30-meter performance
- High power 4O3A Signature Series Triplexer enables multi-multi operation on city lot!

Call or e-mail us for a free catalog!

See our entire line of DX/Contest station antennas and station components at **www.Force12Inc.com** (Worldwide), **www.InnovAntennas.us** (North & South America) and **www.InnovAntennas.com** (Europe and ROW). Toll Free: (US) 888-998-8541 - (UK) (0)800 0124 205

How Does Your Antenna Measure Up?

The exciting new CAA-500 Antenna Analyzer by Comet provides simultaneous display of SWR and impedance readings from 1.8 to 500 MHz!



The Primary Tool For Any Antenna Project

- Dual cross-meter real-time display of SWR and Impedance with high accuracy.
- Seven frequency ranges (Including 222 MHz) extending up to 500 MHz!
- Thumb-wheel frequency adjustment for effortless sweeps of antenna operating range.
- Two antenna jacks, "SO-239" and "N" (above 300 MHz).
- Internal battery power or external DC (8 - 16 Volts).

Protective soft case CAA-5SC now available!

COMET™

For a complete catalog, call or visit your local dealer.
Or contact NCG Company, 15036 Sierra Bonita Lane, Chino, CA 91710
909-393-6133 800-962-2611 FAX 909-393-6136 www.natcommgroup.com

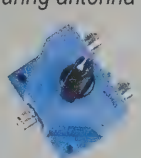
Accurate Measurements. No Excuses!

Professionally Engineered Cross Needle Meters

Forward power, reflected power and VSWR are displayed simultaneously! No calibration required! Daiwa high quality instruments make the tedious measuring of SWR and Power during antenna tests, transmitter matching and tuning a very easy task.

NEW! POWER SUPPLY
SS-330W Convenient, lightweight 30 amp switching supply.
- 30 amps continuous, 33 amp peak
- Dual meters
- Adjustable voltage (5–15V)
- Built-in fan
- Weighs less than 5 lbs.
- Carrying handle

NEW! POWER SUPPLY
SS-505 Lightweight switching power supply.
- 50 amp continuous, 55 amp peak • Adjustable voltage, 5-15V
- Can be used for DC motors requiring peak start-up voltage
- Dual-use V/A meter
- Built-in fan
- Weight: 8lbs 6 oz
- Carrying handle



COAX SWITCHES
Patented design and excellent RF characteristics. Automatic grounding of unused circuits with heavy-duty diecast cavity construction.

CS-201
- 2-position 600MHz switch
- Max. power: 2.5kW PEP/1kW CW
- Conns: SO-239

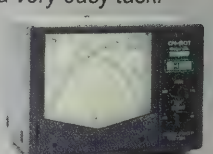
CS-201GII
- 2-position 2GHz switch
- Max.power: 1.5kW CW
- Conns: Gold plated N-type

ECONOMY SERIES
Accurate and dependable bench meters at an economy price.Lighted,13.8VDC jack on rear panel. 6"l x 3"h x 4"d (approx.)

CN-101
- Frequency range: 1.8-150MHz
- Forward power ranges. 15/150/1500W

CN-103M
- Frequency ranges: 140-525MHz
- Forward power ranges: 20/200W

CN-103N
- Same as CN-103, but with N-type connectors



PROFESSSIONAL SERIES
Accurate and dependable featuring a large,easy-to-read lighted meter.13.8VDC jack on rear panel. 6"l x 4 1/4"h x 4 1/2"d (approx.)

CN-801HP
- PEP reading SWR/power meter
- Frequency range: 1.8-200MHz
- Forward power ranges: 20/200/2000W

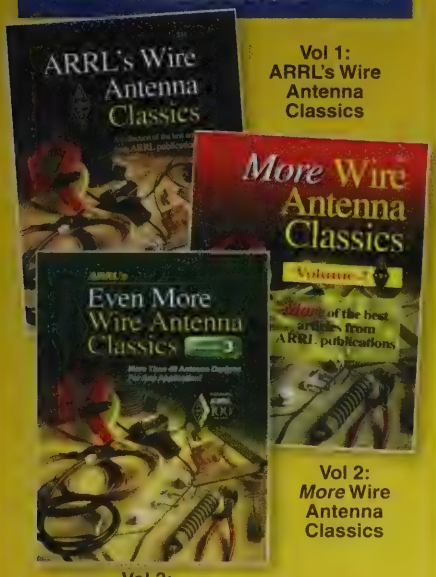
CN-801V
- Frequency range: 140-525MHz
- Forward power ranges: 20/200W

NEW! CN-801G *D-STAR*
- Frequency range: 900-1300MHz
- Forward power ranges: 2/20W
- N-type connectors

DAIWA

For a complete catalog, call or visit your local dealer.
Or contact NCG Company. 15036 Sierra Bonita Lane, Chino, CA 91710
909-393-6133 • 800-962-2611 • FAX 909-393-6136 • www.natcommgroup.com

Wire Antenna Classics



Vol 1: ARRL's Wire Antenna Classics

Vol 2: *More* Wire Antenna Classics

Vol 3: Even More Wire Antenna Classics

Antennas to build and ideas to experiment with...

Wire antennas are the best antennas to use to get on the air simply and inexpensively. Experience the satisfaction of building your own wire antennas.

Now you can enjoy a collection of the best antenna articles from ARRL publications. Inside these books, you'll find more than just creative ideas. Each is filled with innovative designs that work!

- Portable Antennas
- Directional Antennas
- Multiband Antennas
- Single Band Antennas
- Stealth Antennas

...and more!

– 3 Volumes –

Volume 1
ARRL's Wire Antenna Classics
ARRL Order No. 7075
Only **$14.00***

Volume 2
More Wire Antenna Classics
ARRL Order No. 7709
Only **$17.95***

Volume 3
ARRL's Even More Wire Antenna Classics
ARRL Order No. 0239
Only **$19.95***

*plus shipping and handling

ARRL *The national association for AMATEUR RADIO®*
SHOP DIRECT *or call for a dealer near you.*
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 3/2015

BALUN DESIGNS

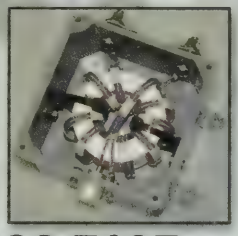
High Grade Baluns and Ununs

www.balundesigns.com

Professionally built Baluns and Ununs for all antenna and feedline applications.

Quality Products at Reasonable Prices

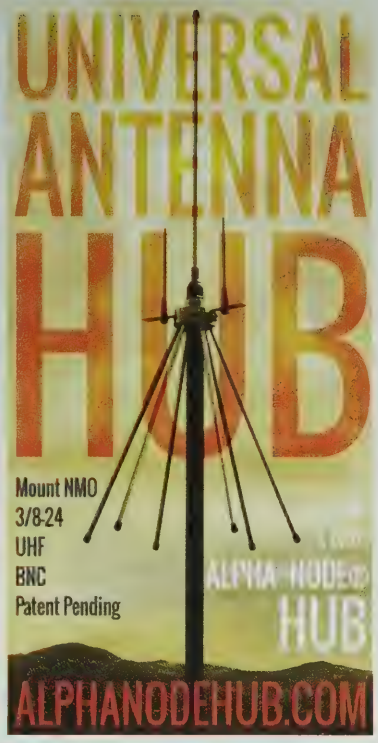
Custom winding on request.



817-832-7197

Create Your Own Custom Antenna!

UNIVERSAL ANTENNA HUB



ALPHANODEHUB.COM

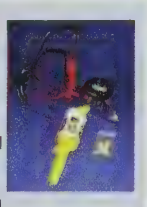
Join or Renew your **ARRL Membership**
www.arrl.org/join

or Create an Online Guest 90-day trial!
Discover the benefits!

TOP TEN DEVICES, Inc.

Big Sale!
Prices Reduced Up to 33% Off!
Band Decoder for Icom/Yaesu/K3
DXDoubler for SO2R Made Easy
Six Way Antenna Relay
ABSS Very High Isolation Relay
Details: www.qth.com/topten

The NEW **EZ HANG** Square Shot Kit
www.ezhang.com



Suggestions from thousands of HAM'S and Cable installers around the world, led to a complete redesign of the **EZ Hang**. Custom designed for YOU, the user in mind. Now safer and easier to use, you will hit your mark every time, with less chance of misfires hitting the yoke.

OVER 11,600 SOLD AROUND THE WORLD!

$99.95 + $9.05 for shipping when paying by check

540-286-0176
www.ezhang.com
EZ HANG
32 Princess Gillian Ct.
Fredericksburg, VA 22406

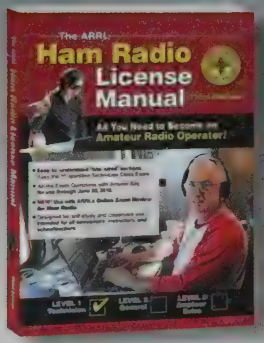
Ultra-Portable, Full Featured
12 Volt Rotor System

Portable Rotation
Portable Antenna Rotor and Support Systems
www.portablerotation.com
sales@portablerotation.com

Mosley... a better antenna!
www.mosley-electronics.com

Discover the Excitement of Ham Radio

with ARRL License Manuals and Online Exam Review



Level 1

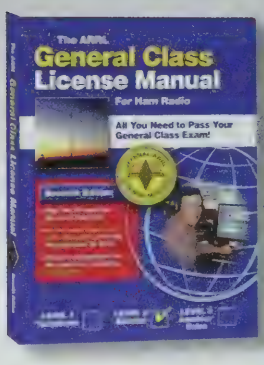
Get your FIRST ham radio license!

The ARRL Ham Radio License Manual—Third Edition

Let ARRL guide you as you get started in Amateur Radio—as you select your equipment, set-up your first station and make your first radio contact.

- **Easy-to-understand "bite-sized" sections.** Pass the 35-question Technician Class exam.
- **Includes the latest question pool with answer key,** for use through June 30, 2018.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- **Designed for self-study and classroom use.** Intended for all newcomers, instructors and schoolteachers.

ARRL Order No. 0222 — $29.95*



Level 2

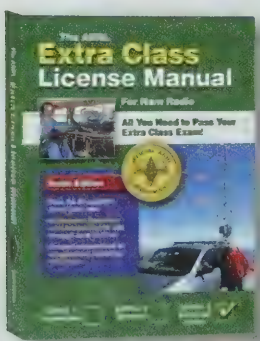
Upgrade and enjoy more frequency privileges!

The ARRL General Class License Manual—Seventh Edition

Upgrade to General and experience the thrill of worldwide communications!

- Pass the 35-question General Class exam.
- **All the Exam Questions with Answer Key**, for use through June 30, 2015.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- Detailed explanations for all questions, including **FCC rules**.

ARRL Order No. 8119 — $29.95*



Level 3

Achieve the highest level of Amateur Radio licensing!

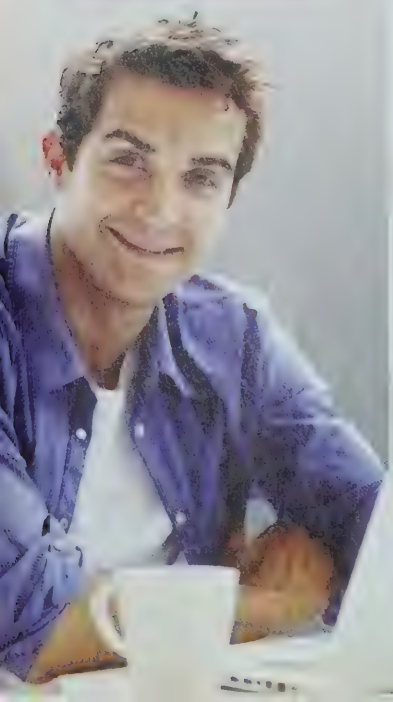
The ARRL Extra Class License Manual—Tenth Edition

Complete the journey to the top and enjoy all the operating privileges that come with earning your Amateur Extra Class license.

- Pass the 50-question Extra Class exam.
- **All the Exam Questions with Answer Key**, for use through June 30, 2016.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- Detailed explanations for all questions, including **FCC rules**.

ARRL Order No. 5170 — $29.95*

*plus shipping and handling



NEW! Online Review and Practice Exams

You won't have any surprises on exam day! For use with ***The ARRL Ham Radio License Manual***, ***The ARRL General Class License Manual***, *and* ***The ARRL Extra Class License Manual.***

www.arrl.org/examreview

As you complete each chapter of ARRL's license preparation study manuals, use ARRL's online **Exam Review** for Ham Radio to help prepare you for exam day. This web-based service uses the question poo to construct chapter-by-chapter reviews. Take practice exams with the same number and variety of questions that you'll encounter on exam day. **ARRL Exam Review for Ham Radio™** is *free*. The only requirement is that users must first set up a site login (a separate login from your ARRL website user registration). Visit **www.arrl.org/examreview** to get started today!

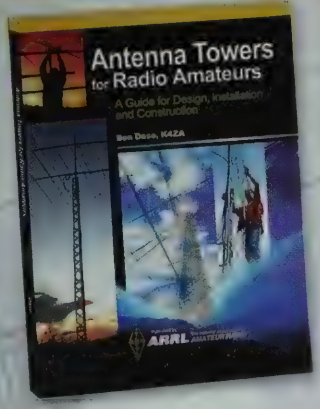
ARRL *The national association for AMATEUR RADIO®*

www.arrl.org/shop

Toll-Free US 888-277-5289, or elsewhere +1-860-594-0355

Antenna Towers for Radio Amateurs

A Guide for Design, Installation and Construction



Make Your Tower Dream a Reality!

Professional tower climber and author **Don Daso, K4ZA**, leads you through the process of designing and building your own antenna tower. He discusses the skills, tools, climbing techniques, and safety measures necessary to improve your antenna system. Whether you aspire to climb and work on an antenna tower yourself, or hire a professional, **this is your guide to success!**

ARRL Order No. 0946
Only $34.95*
*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)
QST 3/2012

GREEN HERON ENGINEERING LLC

RT-21 DIGITAL ROTATOR CONTROLLER

Unmatched Performance for any Rotator

NEW! RT-21 AZ/EL

"Point-and-Shoot" preset, USB and RS-232 control, manual push buttons
Effective ramp up/down reduces stress on tower and antennas
Soft Limits support side mount or extended travel with shortest rotate to heading
Master/slave for stacked arrays - Advanced features not found anywhere else

WIRELESS NETWORK CONTROLS

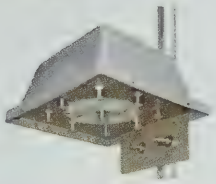
Shared access and Internet control for all of your devices
Eliminates control cables and tethered control boxes
Create your own customized on-screen controls

GH Everyware Base and Remote

- USB and wireless relay controls
- LEDs for TX/RX activity, and signal strength
- Available Options include outdoor enclosures and external antennas.

Select-8 Wireless Remote Coax Switch

- Built-in GHE Wireless Remote and Bias 'T' for through the coax power
- Tower leg Mount
- Amphenol RF connectors



website: www.greenheronengineering.com ♦ email: info@greenheronengineering.com ♦ phone: (585) 217-9093

Classified QST HAM ADS

Amazing deals await you in the pages of QST

Categories include:
Clubs/Hamfests/Nets
Property/Vacation/Rentals
Antique/Vintage/Classic
QSL Cards/Call Sign
Novelties
and that's not all...

See pages 162 & 163

#1
Ham Radio Books and CDs from ARRL!
www.arrl.org/shop

Frohe Weihnachten · Merry Christmas · Joyeux Noël · Feliz Navidad · Buon Natale · vrolijk kerstfeest

KUHNE electronic
MICROWAVE COMPONENTS

Besuchen Sie uns in unserem neuen Online-Shop!
Visit us in our new Online-Shop!

Hyvää Joulua · Sretan Božić · God Jul · Veselé Vánoce · Mutlu Noeller · Boldog Karácsonyt

CommRadio CR-1a Air Superiority Receiver

For complete review, see Dec QST, page 41
WRTH: 'Best New Receiver 2014'

Int'l 10 Hr Li-Ion Battery or Ext'l Power

Rugged MIL-SPEC Quality
True SDR
Stand-Alone Operation
USB-IQ Out

designed and manufactured in Golden, CO USA

TIMEWAVE TECHNOLOGY INC.

Available at:
- Universal Radio
- AES
- HRO
- Radio City
- R&L Electronics

The *Navigator* Sound Card Modem

See QST Short Takes Review - May 2014-P. 62

- Single USB connection to computer
- USB Sound Card built-in
- USB Powered
- Universal Rig Control built-in - logic level +/-, CI-V, CAT, & RS-232!
- Software Configuration - *No jumpers!*
- FSK Controller for Precise RTTY
- K1EL Paddle & Keyboard Precise CW
- Separate COM ports for PTT, FSK, CW, CI-V/CAT & RS-232 - *no port splitters!*

- *Quiet - hear what others miss!*
- *Convenient - No annoying jumpers!*
- *Precise - FSK & CW controllers on board*
- *Complete - Six COM ports*

The *Navigator* is a complete USB sound card modem featuring a proven USB audio sound card chip, six FTDI USB serial COM ports, a K1EL WinKeyer, True FSK and rig control connections for every radio. It has a built-in USB sound card with isolated audio I/O to your radio to prevent ground loops. A second audio input lets you use both receivers in a dual receiver radio. The logic level and RS-232 rig control ports support your Icom CI-V, Yaesu CAT, Kenwood and other radios. Front panel controls set both RX audio levels, TX audio ouput level, audio monitor level and the CW speed. There are no annoying internal configuration jumpers - just conveniently set the software-controlled configuration settings from your PC.

Need Software? Check the Ham Radio Deluxe & Radio Operating Center bundle!
Optimized for the Navigator, PK-232SC+ and other Timewave/AEA TNCs www.ham-radio-deluxe.com

PK-232SC+ with New Dual Port Option!

PK-232SC+ Multimode Data Controller*

Sound Card, Rig Control, USB, Pactor, RTTY, CW Packet, Dual Port Option & more!

100,000 sold - All-time top selling data controller!

- Dual Port - two radios at same time!
- Single USB connection to computer
- USB Sound Card built-in
- 3-Way Rig Control built-in - logic level, RS-232 & USB!
- Computer isolated from radio
- Real FSK and high-speed keyboard CW

For the first time in 23 years, we tweaked the PK-232's main PC board! Now with a dual port option, the incredible PK-232SC+ again expands its role in your radio station. The new PK-232SC+ can operate legacy modes on one port and sound card modes on the other - simultaneously! The SC+ connects to your computer with a single USB cable - no audio cables, no RS-232 cables! It has a built-in USB sound card with isolated audio I/O to your radio to prevent ground loops. The logic level and RS-232 rig control is optically isolated for your Icom CI-V, Yaesu CAT, Kenwood and other radios. A new optically isolated DTR PTT option works with legacy sound card software and radios. We even added a pair of USB ports for that new radio with USB rig control and other accessories.

**Upgrade any PK-232 to the PK-232SC with New Lower SC & DSP Upgrade Combo Pricing!*

Customize your PK-232 installation with our complete line of upgrades, accessories and cables.

- **HamLinkUSB™ Rig Control+**
  CI-IV, CAT, RTS (PTT, FSK or CW) for sound card software
  Perfect for HRD owners with simple sound card adapters
- **HamLinkUSB™ USB-to-RS-232 Adapter**
  Proven FTDI Chip. 9 and 25 pins for all radios and TNCs!

Timewave Technology Inc.
23 Empire Drive
St. Paul, MN 55103 USA
651-489-5080
Fax 651-489-5066
www.timewave.com
sales@timewave.com

MFJ ANALYZERS

MFJ-259C . . . World's Most Popular Antenna Analyzer!

New! MFJ-259C **$299.95**

Super easy-to-use!
Dual analog meters, LCD
New and improved, now covers 530 KHz-230 MHz!

World famous MFJ-259C gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259C is a complete ham radio test station including -- frequency counter, RF signal generator, *SWR Analyzer*™, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

You can read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

You can read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy to use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR and Complex Impedance are displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $15.95. Rugged metal cabinet only 4x2x6¾ inches.

MFJ *No Matter What*™ Warranty

Every MFJ analyzer is protected by MFJ's famous one year No Matter What™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

MFJ-249C, $279.95. If digital display is all you need MFJ-249C does everything MFJ-259C does without analog meters.

More hams use MFJ analyzers than all others in the world!

MFJ-269C 530 KHz - 230 MHz *plus* 415-470 MHz, 12-bit A/D

MFJ-269C **$399.95**

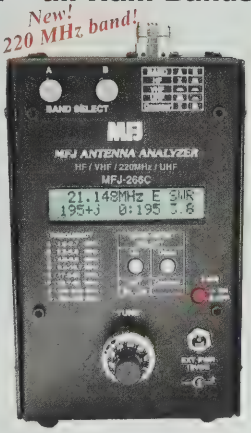
New!

MFJ-269C is a *super* MFJ-259C that adds 415-470 MHz and 12-bit A/D converter that gives you much better accuracy. *Complex Impedance Analyzer* reads series/*parallel* equivalents and magnitude/phase. *CoaxCalculator*™ gives line length from electrical degrees and vice-versa for any frequency, Velocity Factor, coax loss in dB. Use any characteristic impedance 10-600 Ohms. Has LCD log SWR bargraph, N-connector.

MFJ-266C 1.5-65, 105-230 300-490 MHz -- *all* Ham Bands

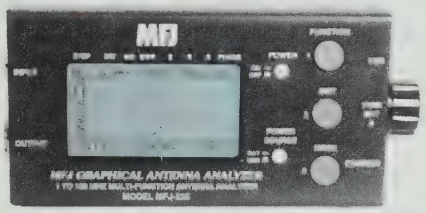
MFJ-266C **$359.95**

New! 220 MHz band!



MFJ-266C *new* compact *wide-range* analyzer covers HF (1.5-65 MHz), VHF (105-230 MHz, including 220 MHz band) and UHF (300-490 MHz). Antenna Analyzer mode reads frequency, SWR, complex impedance *simultaneously*. 500 MHz freq. counter mode has 100 Hz resolution, measures relative field strength/frequency for tracking interference. Signal Generator mode, solid-state switching, and electronic tuning. Backlight, N-connector.

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer



MFJ-225 **$299.95**

Out in the field, MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-269C*PRO*™ Analyzer

MFJ-269CPro, $429.95. Like MFJ-269C, but UHF range covers *430 to 520 MHz* to include commercial and industrial frequencies. Rugged protective shell protects knobs, switches, meters, digital display for commercial, industrial and lab work.

HF/VHF/UHF SWR Analyzer™

CLOSEOUT!!!

MFJ-266B, $299.95. Has all the features of MFJ-266C but MFJ-266B covers 1.5-65 MHz, 85-185 MHz and 300-490 MHz. Does not cover 220 MHz band.

HF/6M SWR Analyzer, 1-60 MHz

MFJ-213, $199.95. Reads SWR, complex impedance, impedance magnitude. Measures capacitance, inductance, field strength, frequency, generate test signals. Fine tune stubs, analyze coax, test baluns, RF transformers, plus other RF tasks.

MFJ SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $24.95.** Carrying Pouch for MFJ-259C/269C.
B. **MFJ-92AA10, $29.95.** 10-Pack 2500 mAh Ni-MH Supercells.
C. **MFJ-66, $24.95.** Dip coils, set of two covers 1.8-230 MHz.
D. **MFJ-731, $99.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
E. **MFJ-917, $29.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
F. **MFJ-5510, $9.95.** 12VDC cigarette lighter adapter.
G. **MFJ-7737, $5.95.** PL-259 to BNC Female.
H. **MFJ-7727, $5.95.** PL-259 to SMA Female.
I. **MFJ-633, $29.95.** Ultra-fast intelligent charger.

Dealer/Catalog/Manuals

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. *Add shipping.*

Prices and specifications subject to change. (c) *2014 MFJ Enterprises, Inc*

HONDA
GENERATORS

What are YOU plugging into?

Super quiet running ~ 53 - 59dB!
(Quieter than normal speech!)
Lightweight & portable
(Easy to carry at less than 50 lbs!)
Extra long run time.
(Runs up to 15 hours on 1.1 gallons!)
Honda inverter technology.
Eco-throttle

EU2000
ARRL Member Special

We feel that what HAM operators provide in times of emergency is often overlooked but incredibly important and deserve a break on generators that will provide power to their equipment.

ARRL Members will receive a discounted price on the EU2000 or EU2000 Companion. Please call for your ARRL Member Discount coupon code.

FREE SHIPPING
IN THE CONTINENTAL 48 STATES

MAYBERRYS.COM
800-696-1745
232 Main St. Port Murray, NJ 07865

Please read your Owner's Manual and all labels before operation.

Ham Computer Stuff
- LOGic 9
- TRX-Manager 5
- USB Rig IFCs

HoseNose.com
PERSONAL DATABASE APPLICATIONS

Buckmaster OCF Dipoles
Built to last from quality materials!
4-Band: 40, 20, 10, & 6 meters
7-Band: 80, 40, 20, 17, 12, 10, & 6m
8-Band: 160, 80, 40, 20, 17, 12, 10, & 6m
BUCKMASTER Since 1982
800-282-5628
540-894-5777
hamcall.net

PROMOTING THE USE OF TEN METERS SINCE 1962
Ten-Ten International Net, Inc.
Awards - QSO Parties - Special Events - Paperchasing
NETS DAILY (except Sunday) on 28.380 and 28.800 at 1800z
CHECK US OUT ON THE WEB
www.ten-ten.org / www.10-10.org
1349 Vernon Ter San Mateo CA 94402-3331

CONNECTOR-ized BOOM MIC. HEADSET
Just plug in listen and talk
$58.95

More than one radio?
⇒ ADAPTERS ⇐
now available for most radios

DIY?
Boom mic headset KITS from $29.95

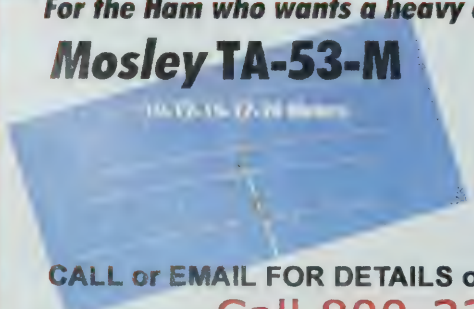
LISTEN ONLY HEADSETS $49.95

NEW RADIO?
We offer NEW connector installation or adapters for almost any mic. or headset.

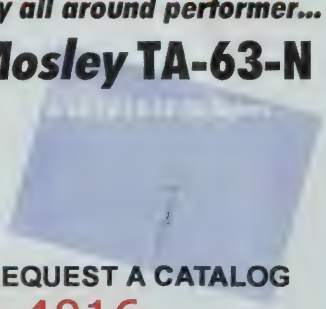
CALL NOW TOLL-FREE
1-800-634-0094
30-DAY MONEY-BACK GUARANTY!
WARREN GREGOIRE & ASSOCIATES LLC
1933 DAVIS ST. SUITE 221, SAN LEANDRO CA 94577, USA
VOICE 510-282-9300• FAX 510-633-9355
WEBSITE www.warrengregoire.com

For the Ham who wants a heavy duty all around performer...

Mosley TA-53-M



Mosley TA-63-N



CALL or EMAIL FOR DETAILS or REQUEST A CATALOG
Call 800-325-4016
Mosley... a better antenna!
www.mosley-electronics.com

NEW!

2014

ARRL Periodicals on DVD!

ARRL's* popular journals are available on a compact, fully-searchable DVD. *Every word and photo published throughout 2014 is included!

- ***QST*** The official membership journal of ARRL
- ***NCJ*** National Contest Journal
- ***QEX*** Forum for Communications Experimenters

SEARCH the full text of every article by entering titles, call signs, names—almost any word. **SEE** every word, photo (including color images), drawing and table in technical and general-interest features, columns and product reviews, plus all advertisements. **PRINT** what you see, or copy it into other applications.

System Requirements: Microsoft *Windows*™ and Macintosh systems, using the industry standard Adobe® Acrobat® Reader® software. The Acrobat Reader is a free download at **www.adobe.com**. *Windows* 8 compatible.

2014 ARRL Periodicals on DVD
ARRL Order No. 0325
Only $24.95*

Additional sets available:
2013 Ed., ARRL Order No. 0093, $24.95
2012 Ed., ARRL Order No. 3152, $24.95
2011 Ed., ARRL Order No. 5651, $24.95
2010 Ed., ARRL Order No. 2001, $24.95
2009 Ed., ARRL Order No. 1486, $24.95
2008 Ed., ARRL Order No. 9406, $24.95
2007 Ed., ARRL Order No. 1204, $19.95
2005 Ed., ARRL Order No. 9574, $19.95
2003 Ed., ARRL Order No. 9124, $19.95
2002 Ed., ARRL Order No. 8802, $19.95

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT *or call for a dealer near you.*
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 1/2015

MFJ *IntelliTuner*™ Automatic Tuners

More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital frequency readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable . . .

MFJ-998 1500 Watt *Legal Limit IntelliTuner*™

Only the MFJ-998 gives you fully automatic antenna tuning for your legal limit full 1500 Watts SSB/CW linear amplifier!

MFJ-998 **$699.95**

Ultra-fast Automatic Tuning

Instantly match impedances from 12-1600 ohms using MFJ's exclusive *IntelliTune*™, *Adaptive Search*™ and *InstantRecall*™ algorithms with over 20,000 *VirtualAntenna*™ Memories.

Safe auto tuning protects amp

MFJ's exclusive *Amplifier Bypass Control*™ makes tuning safe and "stupid-proof"!

Digital/Analog Meters

A *backlit* LCD meter displays SWR, forward/reflected power, frequency, antenna selected, an auto-ranging bargraph power indication, and much more.

Has quick-glance auto-ranging Cross-Needle SWR/Wattmeter.

MFJ VirtualAntenna™ Memory

MFJ new *VirtualAntenna*™ Memory system gives you 4 antenna memory banks for *each* of 2 switchable antenna coax connectors. Select up to 4 antennas on each antenna connector. Each antenna has 2500 memories, 20,000 total. Has binding post for end-fed long wire antennas.

Download & Upgrade Remotely

Download from internet and upgrade your MFJ-998 firmware as new features are introduced.

Plus Much More!

Built-in radio interface controls most transceivers.

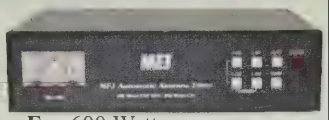
Automatically bypasses with excessive tuning power.

Use balanced line antennas with external **MFJ-912, $59.95**, 1.5 kW 4:1 balun.

Small 13Wx4Hx15D inches easily fits into your ham station. 8 pounds. Requires 12-15VDC at 1.4 amps maximum or 110 VAC with **MFJ-1316, $21.95**.

for 600 Watt amps

AL-811/ALS-600/ALS-500



For 600 Watt amps like Ameritron AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. 10,000 *Virtual Antenna*™ memories. Cross-Needle SWR/Wattmeter. 10Wx2¾Hx9D inches.

MFJ-994B **$359.95**

***No Matter What*™ Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

300 Watt...Best Seller

Digital Meter, Ant Switch, Balun

The *world's best selling* automatic antenna tuner is *highly acclaimed the world over* for its ultra high-speed, wide matching range, reliability, ease-of-use! Matches virtually *any* antenna.

MFJ-993B **$269.95**

300 Watt...Extra...Wide Range

SWR/Wattmeter, 10000 VA Memories

***Extra** wide matching range at less cost.* Exclusive dual power level: 300 Watts/6-1600 Ohms; 150W/6-3200 Ohms. Cross-Needle SWR/Wattmeter.

MFJ-991B **$229.95**

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ and *InstantRecall*™ algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR.

MFJ-929 **$229.95**

200 Watt ...Econo

Small, Ant Switch, 20K VA Memories

High-speed, wide matching range and compactness at low cost! Leave in-line and forget it -- your antenna is *always* automatically tuned! 2-position antenna switch.

MFJ-928 **$199.95**

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

No extra space needed! Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- it's all you need for a completely automated station using *any* antenna! Just tune and talk!

MFJ-925 **$179.95**

G5RV Antenna

MFJ-1778 **$44.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 ft. long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi.1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* end insulators. All hand-soldered connections. Add coax, some rope and you're *on the air!*

MFJ-1778M, $39.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

200W...Weather-sealed

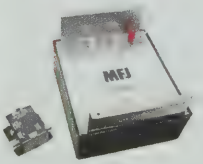
for Remote/Outdoor/Marine

MFJ-926B **$279.95**

***Fully** weather-sealed for remote Outdoor/Marine use*! Tough, durable, built-to-last the elements for years.

200 Watt...Remote

Coax/Wire Ant, No pwr cable needed



MFJ-927 **$259.95**

Weather protected fully automatic *remote* auto tuner for wire ***and*** *coax* antennas -- an MFJ exclusive. Powers through coax -- No separate power cable needed.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

Prices and specifications subject to change. (c) 2014 MFJ Enterprises, Inc.

http://www.mfjenterprises.com for instruction manuals, catalog, info

HamPROS | Radio City, Inc.

2663 County Road I, Mounds View, MN 55112
www.radioinc.com, 800-426-2891

Associated Radio
8012 Conser
Overland Park, KS 66204
www.associatedradio.com
800-497-1457

Lentini Communications, Inc.
216 Christian Lane – Unit C
Berlin, CT 06037-1450
www.lentinicomm.com
800-666-0908

Universal Radio, Inc.
6830 American Pkwy.
Reynoldsburg, Ohio 43068
www.universal-radio.com
800-431-3939

Yaesu

FT-991
This device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased until authorization is obtained

VX-8DR
5 watts FM on 50/144/430 MHz

YAESU DR-1X
C4FM/FM Dual Band, Repeater Base Station, 144/430 MHz, C4FM/FM Digital Repeater. Features Three Digital Modes and a Conventional FM mode. Supports operation on an Emergency Battery.

NEW! Unique AM3 Capability!

Coming Soon! The New Yaesu FT-2DR Touch Screen Digital/FM HT

NEW! New Low Price!

YAESU FTDX-1200
TX Frequency Coverage: 160 to 6 meters, 5 to 100 watts (2 to 25 watts AM)

Welcome to a New Digital World!

FT-1DR
New Exciting Price!

FT-270R **VX-6R**

YAESU – FTDX3000D
Premium HF/50MHz Transceiver, Full color TFT display

FT-817ND
HF/6/2/440

New Low Price!

FT-450D
state of the art IF DSP technology, world class performance, easy to use

FT-7900R
Dual bander High-power Output 1000 memories

FT-857D
HF/6/2/440 all mode

FTM-400DR
is making News!
Wow, New Repeaters Online!

FT-897D
Limited to Stock on Hand
HF/6/2/440 all mode Portable 100W HF/6, 50W 2M, 20W, 440MHz
Limited to Stock on Hand

FT-8900R
10M/6M/2M/440MHz

FT-1900R
144-148MHz

FT-2900R
2 meter transceiver

Kenwood

TS-990S
Kenwood s NEW Flagship HF/50MHz

TH-F6A
Compact 144/220/ 440MHz

TS-480HX/ TS-480SAT
HF/6M

TM-D710GA
2M/70cm Mobile 50W/50W, Optional Voice Synthesizer

TH-K20A
RF Output, Backlit LCD, Weather Alert, Keypad Entry

TM-V71A
1000 Alpha Memories, Dual Display

NEW!

TS-590S
160-6 meters, Noise Reduction

TS-2000S/ TS-2000X
High performance true IF/stage DSP on main band.

TH-D72A
144/440 MHz , 5W HT/GPS/ TNC

TM-281A
2M, FM Mobile Transceiver, 200 memory channels

Icom

Icom IC-2730A
144/440 MHz mobile

NEW!

Also Available: ID-51A, ID-31A, IC-7700, IC-7800, IC-7410, IC-7200

IC-7100
All-mode HF/VHF/UHF mobile transceiver

Icom ID-5100A
2m/440 dual band mobile

Anytone, TYT, TDXone and Wouxun

Anytone AT-5888UV
VHF/UHF 50/40 watts, Detachable Front Panel, True Dual Receive, 758 Memory Channels, Software Programmable, Selectable 35/10/5 watts, 2013 narrowband compliant, FCC Certified

Wouxun KG-UV920P-A
VHF/UHF Dual Display, 50/40 watts, 4 power settings, Detachable Front Panel, 999 Memory Channels, Programmable, FCC Certified

NEW!

The NEW Wouxun KG-UV950P is back in stock!
Quad Band, Duplex Cross-Band Repeat, Dual Receive, Dual-Track & Dual-Speaker, Dual Display

Ham Radio Starter Kit
$69.95 – a $94.85 value
Package includes:
• DXone Q8 2m/440 HT
•Technician Manual by Gordon West • FCC Part 97 Rule Book • FAQ Guide
Radio Only $59.95

Q8 Accessory Kit
$39.95 – a $64.85 value
Package includes
• Speaker Microphone
• 1800 Mahr/Li-On Battery
• Soft Case and a bonus Gift

Programmed Repeaters in your QSA $14.95

New LED Emergency Desk Lamp

Temp Gauge
Checks your gear and shack

Antennas and Mounts

SX-5 144/430 Base Station Antenna
Frequency(MHz) 144/430
Zo(Ω): 50
V.S.W.R: <1.5
Power(W): 200
Length(m): 1.7
Weight(g): 900
SX-3 & 5 are also available.

NEW! **SBBX 220 Black Antenna**

KY-66B Trunk Lid/ Hatch-back Mount
Door Mount
Weight 168g

Max-1 PL/NMO in Black!
Frequency (MHz) 144/430
Max Power(W) 60
V.S.W.R: <1.5
Length (M): 0.92
Weight(g) 135
Connector PL-259

NEW!

WP-110 Antenna
Frequency (MHz): 144/430 MHz
Z (ohms): 50
Max Power: 10W
Length (mm): 400
Weight: 42g
Connector SMA

P-800 Small External Speaker
Speaker Max Power: 5 watts
Cord Length: 4 Meters

UL-01 Hatchback
Door Trunk Lid Mount. Color: Black. Weight. 202g

RB-90 Trunk Mount
Tilt angle adjustabe mount

KG-UV8D
999 Channel Handheld Dual band 2M/440 LCD color display

KG-UV6D
VHF/UHF Dual Band 2.5kHz VFO steps, 2013 Narrowband compliant.

TH-UVF1A
TX 144-148/430-450MHz RX: 136-174/400-470MHz

Power Supplies

NEW! Improved dual V/20 amp Current Meter. New heavier wire to handle SSB duty cycle at 20 amps.

Talking Clocks! Available in Red, Green, Blue, or Yellow Trim

Back in Stock! New Price!

QJE PS50SWIII Switching Power Supply

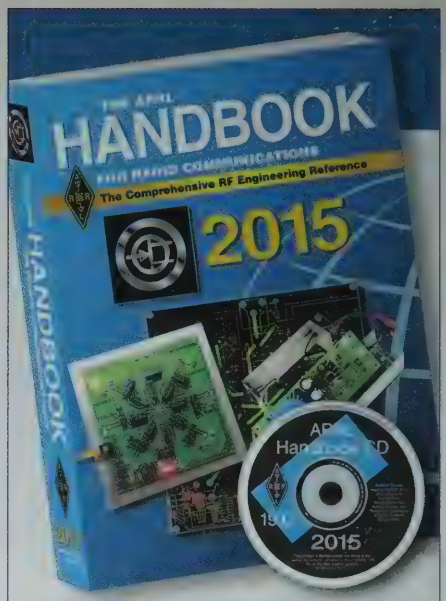
QJE PS30SWI DC Power Supply
Output voltage DC13.8~0.7V

QJE PS30SWIV
30 amps Max (10% duty cycle), 20 amps continuous 110/220 vAC

QJE PS30SWV DC Power Supply*
DC 13.8V Output. (9-15V adjustable)
*Back in Stock!

Mini DVM 3-30 Volts from $4.95

We Sell ARRL Books!



ARRL Handbook

The Comprehensive RF Engineering Reference

2015 Edition

This 92nd edition of ***The ARRL Handbook*** is at the forefront of the growing field of wireless telecommunications. Many projects and construction articles are included to help enhance your station and expand your participation as an active radio experimenter. Practical applications and solutions make ***The Handbook*** a must-have for hobbyists and technical professionals, finding its way onto workbenches, operating desks, and into university libraries and classrooms.

Includes:

- Electrical Fundamentals
- Analog and Digital Basics
- RF Techniques
- Computer-Aided Circuit Design
- Power Supplies and Modulation
- Oscillators and Synthesizers
- Mixers, Modulators and Demodulators
- RF and AF Filters
- Receivers, Transmitters and Transceivers
- DSP and Software Radio Design
- Digital Modes
- RF Power Amplifiers and Repeaters
- Propagation of Radio Signals
- Transmission Lines and Antennas
- Construction Techniques
- Station Accessories
- Test Equipment and Measurements
- Troubleshooting and Maintenance
- RF Interference
- Safety and Assembling a Station

Softcover Book and CD-ROM
ARRL Order No. 1920
Only $49.95*

Hardcover Book and CD-ROM
ARRL Order No. 0218
BONUS! Save $10.00 while supplies last
Only $49.95* (retail $59.95)

*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 2/2015

MFJ TUNERS

Ham Radio's *Most Popular* 300 Watt Antenna Tuner

More hams use MFJ-949s than any other antenna tuner in the world!

Why? Because the world's leading tuner has earned a worldwide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas . . . Use coax, random wire, balanced lines. Has heavy duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, *Teflon*® insulating washers and proper L/C ratio gives you *arc-free* no worries operation

MFJ-949E **$189.95** up to 300 Watts PEP transceiver input power.

The MFJ-949E inductor switch was *custom* designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full size 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, *peak* or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's *QRM-Free PreTune™* lets you pre-tune your MFJ-949E *off-the-air* into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full size built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, 10⅝x3½x7 inches. Superior cabinet construction and more!

MFJ-948, $169.95. Econo version MFJ-949E. Has all features except for dummy load.

***No Matter What™* Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What™* limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

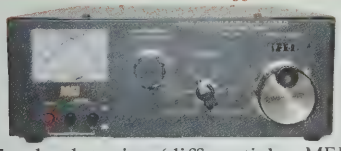
More hams use MFJ tuners than all other tuners in the world!

MFJ-989D *Legal Limit* Tuner

MFJ-989D **$409.95**

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. Easily handles *full* 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. *New* 500 pF air variable capacitors. *New* improved *AirCore™* Roller Inductor. *New* high voltage current balun. *New* crank knob. 12⅞Wx6Hx11⅝D".

MFJ-986 Two knob *Differential-T™*



MFJ-986 **$369.95**

Two knob tuning (differential capacitor and *AirCore™* roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 10¾Wx4½Hx15 in.

MFJ-962D *compact* kW Tuner

MFJ-962D **$319.95**

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore™* roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 10¾x4½ x10⅞ in.

MFJ-969 300W *Roller Inductor* Tuner

MFJ-969 **$229.95**

Superb *AirCore™* Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune™*, antenna switch, dummy load, 4:1 balun, Lexan front panel. 10½Wx3½Hx9½D inches.

MFJ-941E *super value* Tuner

MFJ-941E **$149.95**

The most for your money! Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek 10½Wx2½Hx7D in.

MFJ-945E HF/6M *mobile* Tuner

MFJ-945E **$129.95**

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8x2x6 in. *Lighted* Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz *and* 6 Meters. 300 Watts PEP. **MFJ-20, $6.95,** mobile mount.

MFJ-971 *portable/QRP* Tuner

MFJ-971 **$129.95**

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6x6½x2½ in.

MFJ-901B *smallest* Versa Tuner

MFJ-901B **$99.95**

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902B *Tiny Travel* Tuner

MFJ-902B **$99.95**

Tiny 4½x2¼x3 inches, full 150 Watts, 80-*6* Meters, has tuner bypass switch, for coax/random wire.

MFJ-904H, $149.95. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. 7¼x2¼x2¾ inches.

MFJ-16010 *random wire* Tuner

MFJ-16010 **$69.95**

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2x3x4 in.

MFJ-906/903 *6 Meter* Tuners

MFJ-906 **$99.95**

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $69.95,** Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921/924 **$89.95**

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x2½x3 in.

MFJ-931 *artificial* RF Ground

MFJ-931 **$109.95**

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $209.95,** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

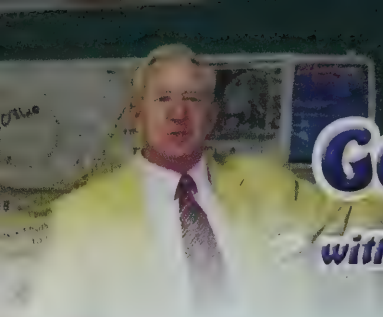
Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What™* warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

Prices and specifications subject to change. (c) *2014 MFJ Enterprises, Inc*



Study with the BEST!

Gordon West, WB6NOA

with Eric P. Nichols, KL7AJ and W5YI GROUP

HAM IT UP! — Gordon West, WB6NOA — The W5YI Group — Study with the BEST!

NEW for the 2014-18 Entry-Level Exam!

Technician Class Book

For the NEW 2014-2018 entry level exam! Gordo reorganizes the Q&A into logical topic groups for easy learning! Key words are highlighted in his explanations to help you understand the material for test success. Web addresses for more than 125 helpful, educational sites. Includes "On The Air!" CD demonstrating Tech privileges. **GWTM $21.95**

Technician Book & Software Package

Gordo's book with W5YI Windows software allows you to study at your computer and take practice exams. Explanations from Gordo's book are on the software – answer a question wrong and his explanation appears to reinforce your learning. Includes free Part 97 Rule Book. **NCS $29.95**

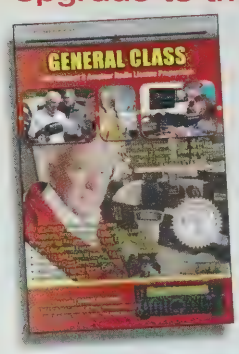
Technician Class Audio Course on CD

Welcome to Gordo's classroom! Technician audio theory course recorded by Gordo talks you through the Element 2 question pool. Follows the order of his Technician Class book, and is full of the sounds of ham radio operating excitement! An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWTW $29.95**

Technician Class Book & Audio CD Value Pack

Technician Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWTP $49.95**

Upgrade to the HF Bands with Gordo & W5YI!



General Class Book

Gordo's manual for 2011-15 reorganizes the questions into logical topic groups for easier learning. His explanations include highlighted key words to help you remember the material for test success. 100 + addresses of helpful, educational websites. Bonus "On The Air!" CD introduces you to General Class HF operation fun. **GWGM $24.95**

General Book & Software Package

Study at your computer and take practice exams. W5YI Windows software includes explanations from Gordo's book, scores your results and highlights areas that need further study. Package includes Gordo's *General Class* book and free Part 97 Rule Book. **GUS $34.95**

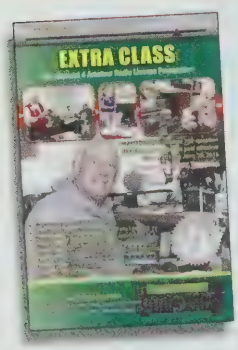
General Class Audio Course on CD

General Theory Course recorded by Gordo is full of the sounds that bring ham radio to life! He talks you through the Element 3 theory to help you understand the material and get you ready for your upcoming exam. An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWGW $29.95**

General Class Book & Audio CD Value Pack

General Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWGP $49.95**

Go to the Top With Gordo — Amateur Extra Class!



Extra Class Book

2012-2016 book includes all Element 4 questions and answers, along with Gordo's educational explanations. Full of Gordo's great memory tricks for those tough math and electronic theory questions (wait 'til you meet "Eli the Ice Man")! Bonus "On The Air!" CD highlights Extra Class operations. **GWEM $24.95**

Extra Book & Software Package

Study at your computer and take practice exams as the W5YI Windows software scores your results and highlights areas that need further study. Software includes explanations from Gordo's book. Package includes Gordo's *Extra Class* book and free Part 97 Rule Book. **ECS $39.95**

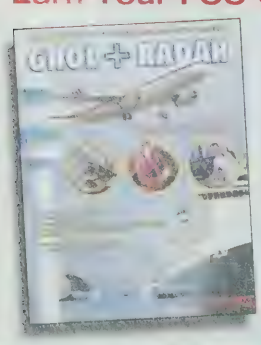
Extra Class Audio Course on CD

Extra Class Theory Course recorded by Gordo talks you through the difficult Element 4 theory to help you understand the material and get you ready for your upgrade to the top – the Amateur Extra Class! An excellent study aid if you spend a lot of time in your car or pick-up! On 6 audio CDs. **GWEW $39.95**

Extra Class Book & Audio CD Value Pack

Extra Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWEP $59.95**

Earn Your FCC Commercial Radio License!



GROL+RADAR Book

Get your FCC commercial radio licenses and add valuable credentials to your resume! GROL+RADAR includes the new FCC Element 1 question pool for the Marine Radio Operator Permit (MROP), the Element 3 pool for the General Radiotelephone Operator License (GROL), and the Element 8 pool for the RADAR Endorsement. Many employers require these licenses for jobs in marine, aero, safety, and municipal positions. Gordo and his team have written clear explanations for all the Q&A to make studying for these exams educational and fun. If you're an Extra Class ham, many of the technical/math questions will look familiar to you. Fully-illustrated to aid your learning. **GROL $49.95**

GROL+RADAR Book & Software Package

Enhance your learning experience using our practice exam software along with the GROL+RADAR book. Windows software includes answer explanations from the book – when you select a wrong answer, the explanation from the book appears to reinforce your learning. **GRSP $79.95**

ORDER TODAY!

on-line at www.w5yi.org or call 800-669-9594

The W5YI Group • P.O.B. 200065 • Arlington, TX 76006

10 Bands: 80-2 Meters

$399.95 MFJ-1799

- *10 Bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6, 2 Meters including 75/80M*
- *Handles 1500 Watts PEP SSB/CW*
- *No ground or ground radials needed!*
- *Low radiation angle for great DX, omni-directional, automatic bandswitching*

Only 20 feet tall! Mounts anywhere!

Self-supporting and just 20 feet tall. Mounts easily from ground level to tower top -- small lots, backyards, apartments, condos, mobile homes, roofs, tower mounts.

Highly Efficient End-Loading

No lossy traps! *End-loading*, the most efficient loading known -- gives you highly efficient performance, excellent bandwidth, low angle radiation and automatic bandswitching.

High-Q loading coils are wound on tough, low loss fiberglass forms with *Teflon*(R) wire where needed.

Entire Length Radiates

End-loading results in uniform current distribution and the *entire length radiates*. This puts the radiating elements up high giving you more QSOs.

No Feedline Radiation/Distorted Pattern

MFJ's center-fed *balanced* halfwave vertical dipole design is decoupled and isolated from the feedline with MFJ's *AirCore*™ high power balun. It can't saturate, no matter how high your power.

This gives you consistently high performance by killing feedline radiation, pattern distortion, SWR shifts, RFI, noise pickups.

Easy to Tune!

Tuning to your favorite part of one band does not affect other bands and is done at the *bottom* of the antenna by simply adjusting a length of the capacitive hat.

Built-to-Last!

Incredibly strong *solid* 1¼ inch diameter fiberglass center insulator and 1⅜ inch diameter 6061 T6 aircraft strength aluminum tubing will make it the only antenna you will ever need.

MFJ 6-Band Halfwave Vertical Antenna

MFJ-1796 **$229.95**

MFJ-1796, like MFJ-1799, but for 6 bands: 40, 20, 15, 10, 6 and 2 Meters. 12 foot high, 24 inch foot print, mounts anywhere. No ground, no radials, self-supporting.

MFJ's Super High-Q Loop™ Antennas

MFJ's *tiny* 36 inch diameter loop antenna lets you operate 10 through 30 MHz *continuously* -- including the WARC bands!

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes. Enjoy DX and local contacts mounted vertically. Get both low angle radiation for excellent DX and high angle radiation for local, close-in contacts. Handles 150 watts.

Super easy-to-use! Only MFJ's super remote control has *Auto Band Selection*™. It auto tunes to desired band, then beeps to let you know. No control cable is needed. Fast/slow tune buttons and built-in two range Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency.

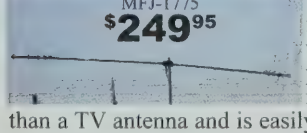
All welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter round radiator -- *gives you highest possible efficiency.*

Each plate in MFJ's tuning capacitor is welded for low loss and polished to prevent high voltage arcing, welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor -- smooth precision tuning. Heavy duty thick ABS plastic housing has ultraviolet inhibitor protection.

Cover 40-15 Meters. MFJ-1788, $499.95. Like MFJ-1786 but covers 40 - 15 Meters continuous. Includes remote control.

6-Band, 40-2 Meters *Rotatable* Mini-Dipole

Low profile 14 feet . . . 7 ft. turning radius . . . 40, 20, 15, 10, 6, 2 Meters . . . 1500 Watts . . .



MFJ-1775 is inconspicuous and low profile -- not much bigger than a TV antenna and is easily tuned by a lightweight rotator like Hy-Gain's *AR-35*.

It's no Wimp! Its directivity reduces QRM/noise and lets you *focus* your signal in the direction you want -- work some real DX.

You can operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters -- and run *full 1500 Watts* SSB/CW on all HF bands!

Features automatic band switching and uses highly efficient end-loading with its *entire length* always radiating. With 6 and 2 Meters thrown in, you have ham radio's most versatile *rotatable* dipole!

Each HF band uses a separate, efficient end-loading coil wound on fiberglass forms with *Teflon*™ wire, and capacitance hats at each end (no lossy traps). 6 and 2 meters are *full-length* halfwave dipoles.

Built-to-last -- incredibly strong solid rod fiberglass center insulator and 6063 T6 aircraft strength aluminum tubing radiator. Assembles in an afternoon. Adjusting one band has little effect on other bands.

MFJ-1775W, $249.95. WARC band version for 12, 17, 30, 60 Meters only.

MFJ *G5RV Antenna*

MFJ-1778 **$44.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 feet long. Can use as inverted vee or sloper. Use on 160 M as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* end insulators. All hand-soldered connections. Add coax, some rope and you're *on the air!*

MFJ-1778M, $39.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

MFJ . . . the world leader in ham radio accessories!

Prices and specifications subject to change. (c) *2014 MFJ Enterprises, Inc*

INRAD
international radio

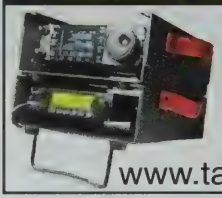
Great Selection of IF Filters for your FT-817/ND, FT-857/D and FT-897/D Radios!

Performance Products for Your Radio!

sales@inrad.net
www.inrad.net
PO Box 2110
Aptos, CA 95001
TEL: 1-831-462-5511
FAX: 1-831-612-1815

Electronic Products Design, Inc.
CUSTOM TRANSFORMERS
Designed to Your Specifications
www.epd-inc.com sales@epd-inc.com
Phone: 919-365-9199 Toll Free: 1-855-752-5134
Fax: 919-365-7005
2554 Lake Wendell Road, Wendell, NC 27591
All units manufactured in the USA.
Family owned and operated for over 25 years.

Tactical Radio Carrier



- Protect
- Package
- Deploy
- Stackable

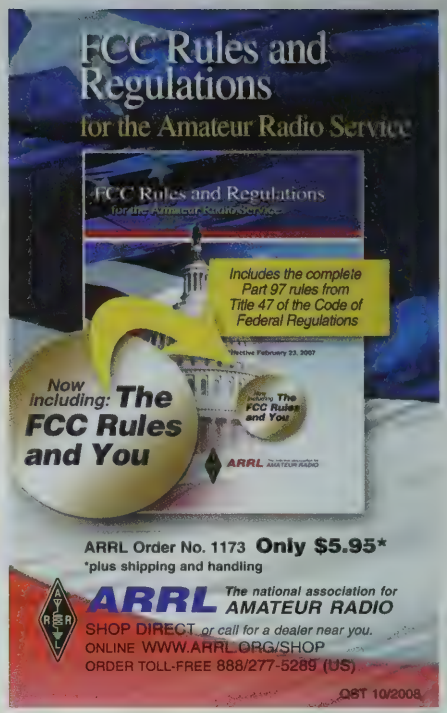
www.tac-comm.com

Advanced Specialties Inc.
"New Jersey's Communications Store"
YAESU ■ ALINCO ■ MFJ ■ UNIDEN ■ COMET
...and much, much more!
HUGE ONLINE CATALOG!
www.advancedspecialties.net
800-926-9HAM ■ 201-843-2067
114 Essex Street, Lodi, NJ 07644

THE TUNER
XMATCH® Antenna Tuners

For info, send $3 to:
7001 Briscoe Lane,
Louisville, KY 40228
HIGH POWER & HIGH EFFICIENCY
Patented & Custom Built by Paul, N4XM
Vacuum Variable Models Available
See http://n4xm.myiglou.com

Join or Renew your ARRL Membership
www.arrl.org/join


FCC Rules and Regulations
for the Amateur Radio Service
Includes the complete Part 97 rules from Title 47 of the Code of Federal Regulations
Now including: The FCC Rules and You
ARRL Order No. 1173 Only $5.95*
*plus shipping and handling
ARRL The national association for AMATEUR RADIO
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)
QST 10/2008

"The Northwest's Largest Ham Convention"

SEA-PAC®

ARRL Northwestern Division Convention

June 5 - 7, 2015

Seaside Convention Center - Seaside, Oregon

2 Workshops on June 5, 2015

Banquet
Seminars
DX & YL Luncheons

NO SALES TAX IN OREGON

Commercial Exhibits
Flea Market Tables
VE Testing

And much more—Right near the Beautiful Pacific Northwest Ocean Beach

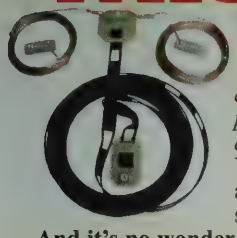
GENERAL INFORMATION
Wayne Schuler, AI9Q
360.892.5580 • info@seapac.org

EXHIBITOR INFORMATION
Warren Winner, W7JDT
503.644.0752 • exhibitors@seapac.org

SEA-PAC on the web: www.seapac.org

MFJ G5RV Antennas

Operate all bands 10 thru 160 Meters with a single wire antenna!



MFJ-1778 **$44.95** *The famous G5RV antenna is the most popular ham radio antenna in the world!* You will transmit and receive strong signals day and night.

And it's no wonder . . . it's an efficient, *all band* antenna that's only 102 feet long -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

Use as Inverted Vee or Sloper and it's even more compact and needs just one support.

With an antenna tuner, you can operate all bands 80 Meters through 10 Meters and even 160 Meters with a ground.

MFJ's fully assembled G5RV handles 1500 Watts. *Ceramic* end and fiberglass center insulators. *Hang and Play™* -- add coax, some rope to hang and you're on air!

MFJ-1778M, $39.95. *Half-size*, 52 foot *G5RV JUNIOR* covers 40-10 Meters with tuner. Handles full 1500 Watts.

MFJ All Band Doublet

MFJ-1777 **$59.95**

MFJ-1777 is a 102 foot *all band* doublet antenna that covers 160 through 6 Meters with a balanced line tuner. Super strong custom fiberglass center insulator provides stress relief for ladder line (100 ft. included). Authentic *glazed ceramic* end insulators. Handles full 1500 Watts.

MFJ *Dual Band* 80/40 *or* 40/20M Dipoles

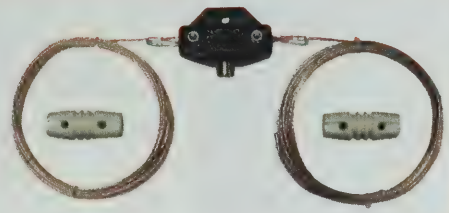
MFJ-17758 **$89.95** 80/40 Meters

MFJ-17758 is a short *dual band* 80/40 Meter dipole antenna that is only 85 feet. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. Full 1500 Watts. Super-strong injection-molded center insulator with *built-in* SO-239 connector and hang hole. Solderless, crimped construction. 7-strand, #14 gauge hard copper wire. Connect your coax feedline directly, *no tuner needed.*

MFJ-17754, $59.95. Short *dual band* 40/20 Meter dipole antenna is only 42 feet. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts. Center insulator with SO-239 connector and hang hole.

MFJ *Single Band* Dipole Antennas

Ultra high quality center fed dipoles will give you trouble-free operation for years. Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole. Heavy duty 7-strand, 14-gauge hard copper antenna wire. Extremely strong solderless crimped construction. Authentic *glazed ceramic* end insulators. Use as horizontal or sloping dipole or inverted vee. Handles full 1500 Watts. Simply cut to length for your favorite frequency with cutting chart provided.



MFJ-1779A **$69.95** 160M, 265 ft.
MFJ-1779B **$49.95** 80-40M, 135 ft.
MFJ-1779C **$29.95** 20-6M, 35 ft.

True 1:1 Current *Balun & Center Insulator*

MFJ-918 **$24.95** **True** *1:1 Current Balun/ Center Insulator* forces equal antenna currents in dipoles for superior performance. Reduces coax feedline radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots in your shack. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® coax connector. Handles full 1.5kW 1.8-30 MHz. Stainless steel hardware with *direct* 14 gauge stranded copper wire connection to antenna. 5x2 inches. Heavy duty weather housing.

RF Isolator

MFJ-915 **$29.95** **MFJ-915** *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted stray RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 5x2 in. Handles full 1500 Watts. Covers 1.8-30 MHz.

MFJ-919, $59.95. 4:1 current balun,1.5 kW.
MFJ-913, $29.95. 4:1 balun, 300 Watts.

Antenna Switches

MFJ-1704 **$79.95** **MFJ-1704** 4-Positions heavy duty *antenna switch* lets you select 4 antennas or ground them for static and lightning protection. Unused antennas automatically grounded. Replaceable lightning surge protection. Good to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW PEP. Less than .2 dB insertion loss, SWR below 1.2:1. SO-239 connectors. Handy mounting holes. 6¼Wx4¼Hx1¼D in.

MFJ-1702C **$39.95** **MFJ-1702C** 2-Positions Like MFJ-1704, but for 2 antennas. 3Wx2Hx2D"

MFJ-1700C **$119.95** **MFJ-1700C** *Antenna/ Transceiver Switch* lets you select one of six antennas and one of six transceivers in any combination. Plug in an antenna tuner or SWR wattmeter and it's always in-line for any antenna/transceiver combination. Has lightning surge protection. Handles 2 kW PEP SSB, 1 kW CW, 50-75 Ohm loads. Unused terminals are automatically grounded. 1.8 to 30 MHz. SO-239 connectors. 4¾W6½Hx3D inches.

MFJ-1701 **$79.95** **MFJ-1701** *Antenna Switch* like MFJ-1700C but lets you select one of six antennas only. 10Wx3Hx1½D inches.

33 ft. Telescoping fiberglass Mast

3.8 feet collapsed, 3.3 lbs.

MFJ-1910 **$79.95** **Super** strong fiberglass mast has huge 1¾ inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee dipole/vertical antenna in minutes and get *full size performance!*

Make your own antennas

Dipoles, G5RV, Random Wire, Doublets, Beverage Antennas, etc.

MFJ-16C06, $4.56. 6-pack authentic *glazed ceramic* end/center antenna insulators.
MFJ-16B01, $19.95. Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole.
MFJ-18G100, $24.95. 100 ft. of flexible, 7-strand, 14-gauge solid copper antenna wire.
MFJ-58100X, $49.95. 100 ft. 50-Ohm RG-8X with PL-259s on each end.
MFJ-18H100, $34.95. 100 feet, 450 Ohm ladder line, 18 gauge copper covered steel.

Lightning Surge Protectors

Ultra-fast gas discharge tube shunts 5000 amps peak. Less than 0.1 dB loss. Up to 1000 MHz. SO-239s. **MFJ-270, $29.95.** 400W PEP. **MFJ-272, $39.95.** 1500W PEP.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. *Add shipping.*
Prices and specifications subject to change (c) 2014 MFJ Enterprises, Inc

http://www.mfjenterprises.com for instruction manuals, catalog, info

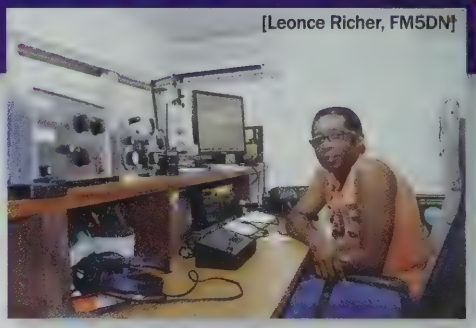
QST QuickStats

sta·tis·tics (st-tstks) n.
1. (used with a sing. verb) The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.
2. (used with a pl. verb) Numerical data.

www.arrl.org/QuickStats

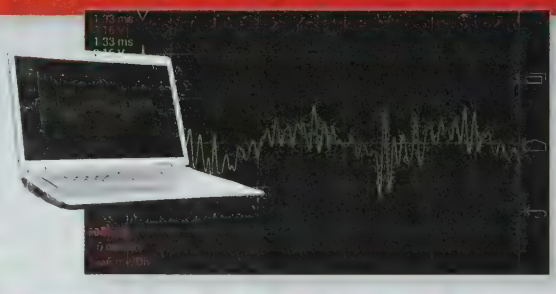
Online QuickStats Poll Results for December 3, 2014 through January 3, 2015.
Get on the web and vote today at **www.arrl.org/quickstats**!

Will you be participating in the 2015 ARRL International DX phone or CW contests?


[Leonce Richer, FM5DN]

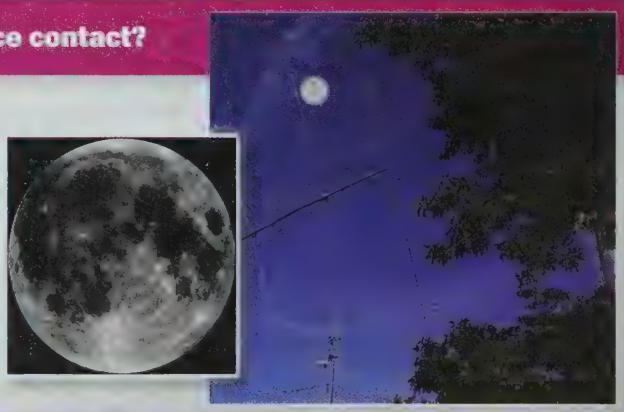
Yes, phone	26%
Yes, CW	9%
Yes, both	22%
No	43%

Does your station computer cause interference on the HF or VHF bands?



Yes, HF	9%
Yes, VHF	3%
Yes, both	4%
No	79%
I don't have a station computer	5%

Have you ever made a Moonbounce contact?



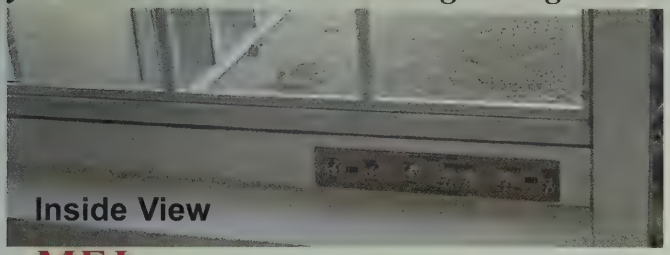
Yes	7%
No	93%

Do you use an external microphone with your handheld FM transceiver?

Yes	53%
No	36%
I don't own a handheld FM transceiver	11%

MFJ Weather-Proof *Window Feedthrough Panels*

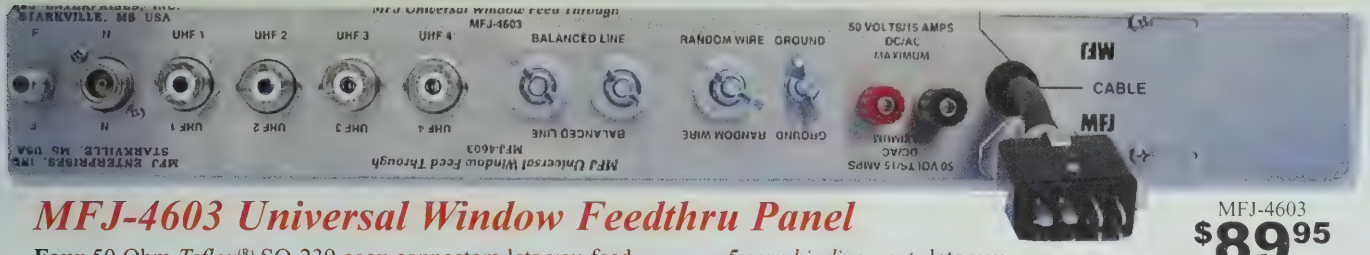
Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!



MFJ Weather-Proof *Window Feedthrough Panels* mount in your window sill. Lets you bring all your antenna connections into your hamshack *without* drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3½ inch high, ¾ inch thick *pressure-treated* wood panel. Has excellent insulating properties. Weather-sealed with a heavy coat of long-lasting white outdoor enamel paint. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.



MFJ-4603 Universal Window Feedthru Panel

MFJ-4603 **$89.95**

Four 50 Ohm *Teflon*(R) SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon*(R) coax *N-connector* lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz *F-connector* makes it easy to bring in television, Satellite, HD, cable TV and FM radio signals.

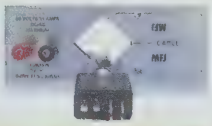
A pair of high-voltage *ceramic feedthru insulators* lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna *ceramic feedthru insulator*.

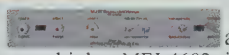
***5-way** binding posts* lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive *Adaptive Cable Feedthru*™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1¼X1⅝ in). Adapts to virtually *any* cable size. Seals out rain, snow, adverse weather.



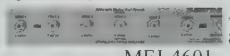
3 Coax, Balanced Line, Random Wire



Best Seller! 3 *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Separate high voltage *ceramic* feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

MFJ-4602 **$69.95**

6 Coax



6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

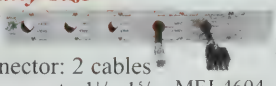
MFJ-4601 **$59.95**

4 Balanced Line, 2 Coax

4 pairs of high-voltage *ceramic* feed-thru insulators for balanced lines and 2 coax connectors.

New! MFJ-4600 **$79.95**

5 Cables, any-size



5 *Adaptive Cable Feedthrus*™. Pass any cable with connector: 2 cables with large connectors up to 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

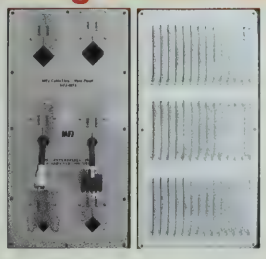
MFJ-4604 **$99.95**

All-Purpose FeedThru/CableThru™

***Stacks** MFJ-4603 **and** MFJ-4604!* Gives you every possible cable connection you'll ever need through your window without drilling holes in wall -- including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605 **$159.95** New!

Bring cables thru eave of your house



MFJ-4616 shown with standard full-size vent (not included) it replaces. For *6 Cables* **$26.95**

MFJ-4613 shown with standard half-size vent (not included) it replaces. For *3 Cables* **$14.95**

Replace your standard air vents on the eave/sofitt of your house with these *MFJ AdaptiveCable*™ *Air Vent Plates* and...

Bring in coax, rotator, antenna switch, power cables, etc. *with connectors* up to 1¼x1⅝ inches!

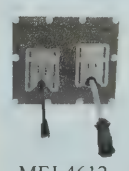
Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ Wall Plates

MFJ-4614 *For 4 Cables* **$34.95**

Bring nearly any cable -- rotator, antenna switch, coax, DC/AC power, etc. -- through walls *without removing connectors* (up to 1¼x1⅝ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes *stainless steel* plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.



MFJ-4612 *For 2 Cables* **$24.95**

MFJ-4611 *For 1 Cable* **$14.95**

Free MFJ Catalog
Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon-Fri *Add shipping.*

Prices and specifications subject to change (c) 2010 MFJ Enterprises, Inc.

http://www.mfjenterprises.com for more info, catalog, manuals, dealers

Celebrate 100 Years of *QST*!

ARRL's monthly Membership journal, *QST*, celebrates 100 years in 2015.
For a century, *QST*, the official journal of ARRL, has been a primary source of timely, engaging, and valuable information for radio amateurs.

These two volumes feature a large collection of important highlights told through the pages of *QST*, published from 1915 to 2013.

A History of *QST* – Volume 1: Amateur Radio Technology

Discover the technical contributions made throughout Amateur Radio's first century. Begin in the era of spark and continue through advances in radio electronics, signal propagation theory, antenna design, and the dawn of satellites and digital communications.

ARRL Order No. 0003
Special Member Price!
Only $29.95 (retail $34.95)

A History of *QST* – Volume 2: Advertising

Do you remember your first radio? Trace the history of receivers, transmitters, antennas, and other station gear through this collection of *QST* pages. It's a nostalgic journey, as told through the creative marketing, advertising and photography of yesteryear.

ARRL Order No. 0048
Special Member Price!
Only $29.95 (retail $34.95)

QST Tablet Sleeve

Black tablet sleeve featuring the *QST* logo. Made from lightweight soft neoprene material, this slim-fit design will protect your tablet from damage, scuffs and scratches. Size: 10" x 8".

ARRL Order No. 0029
Only $5.95

QST Pin

Commemorative *QST* full color die-struck pin. Size 1" x 0.5". While supplies last

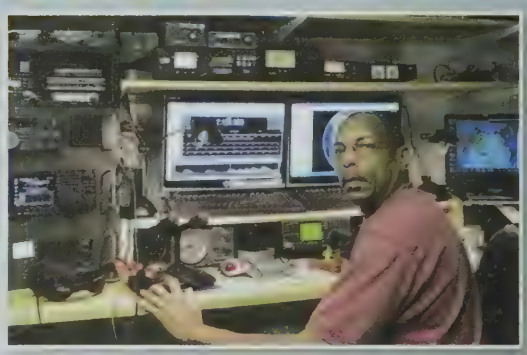
ARRL Order No. 0070
Only $5

QST Centennial Photo Contest is Underway!

The *QST* Centennial Photo Contest celebrates the 100th year of the ARRL's membership journal (the first issue of *QST* was published in December 1915). Now through August 1, 2015, ARRL members can submit photos for consideration as possible 2015 *QST* covers. In addition to having their photos grace *QST* covers, each winner will receive $250.

We're hoping to showcase a number of member photos on 2015 covers," said *QST* Editor in Chief Steve Ford, WB8IMY. "We've also planned a few 'surprise covers' that I think readers will enjoy."

Contest Rules: Images must be submitted by e-mail to **upfront@arrl.org** (one image per message). You can submit multiple images but can win only once. Winning images will be selected by the *QST* Editorial Staff.



Lester "Chucky" Hudgins, N3LH, of New Market, Maryland. Photo Contest Winner February 2015 *QST*.

ARRL The national association for AMATEUR RADIO®

100 Years of QST 1915-2015

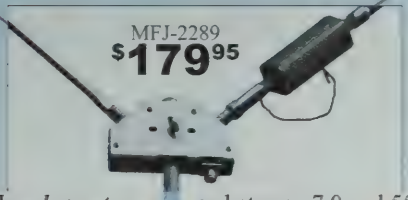
www.arrl.org/shop

Toll-Free US 888-277-5289,
or elsewhere +1-860-594-0355

MFJ BigEAR™

8-Band Portable Dipole

34 feet Radiators
Covers 7-55 MHz



MFJ-2289
$179.95

Whether you're relaxing in the mountains or beach or at your antenna restricted neighborhood, MFJ's BigEAR™ portable HF dipole puts out a strong full-size dipole signal!

Full Size Performance

BigEAR's™ whopping 34-feet stainless steel radiator -- *twice the length* of other portables -- gives you *full-size dipole* performance on 20-6 Meters. New *ultra low loss*, wide-spaced adjustable *air-wound* loading coil gives you highly efficient loaded dipole performance on 30/40 Meters and when radiators are shortened.

Full-size and ultra low loss loading coil is a winning combination that stands head and shoulders above shorter backpack antennas. All your power is radiated, not wasted in loading coils.

Rotatable Dipole Directivity

BigEAR's™ dipole pattern lets you aim a strong main lobe toward your QSO or null out QRM by simply rotating your tripod or mount.

True General Coverage

You can tune it up with exceptionally low SWR on any frequency between 7.0 and 55 MHz. Handles QRP to a full killowatt PEP.

Element Tips High In-the-Air

Distinctive V-shaped elements are set 45 degrees from the horizon to keep element tips high in the air. This maximizes radiation, minimizes ground loss and prevents hazardous contact.

Built-in Guanella Current Balun

Current Balun gives you consistent high-performance. Kills feedline radiation, pattern distortion, SWR shifts, RFI, noise pickup.

True Backpack Portability

Antenna is over 34 feet long fully extended, but disassembles and collapses to 27 inches in seconds. Fits most backpacks or suitcases! Just 2 pounds -- you'll hardly know you are packing it!

Goes Up Fast

Fewer parts to assemble. Much faster tune-up procedure. Heavy-duty aluminum center block instantly mounts on any mast/tripod up to 7/8 inches with MFJ's heavy-duty *NoTool™* mast lock. SO-239. For confined spaces, shorten whips and use loading coil to resonate.

BigStick™ 18-foot Portable Vertical

For the Ham on-the-go!

Carry a BigStick™ for strongest, loudest portable signal on the band!

MFJ-2286
$99.95

MFJ's extra long 17 foot stainless-steel telescoping whip gives you *full-size antenna* for full size performance 20 to 6 Meters but collapses to just 28 inches.

An ultra low loss, high-Q adjustable *air-wound* loading coil gives you highly efficient operation on 30/40 Meters.

This extra long radiator and ultra low loss loading coil is a winning combination that stands head and shoulders above shorter backpack antennas.

Antenna is 18 ft. fully extended. Disassembles and collapses to 28" in seconds. Fits most packs or suitcases! Just 2 pounds, you'll hardly know you are packing it!

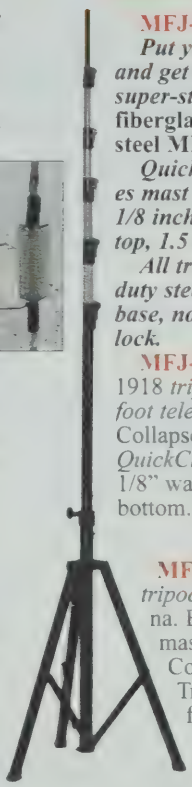
Tapped loading coil covers 7-55 MHz without gaps. Great for Ham Bands and outstanding for image-free shortwave broadcast!

Everything included for instant operation. Easily mounts to any mast up to 1/2 inch. SO-239 for coax. 3/8-24 antenna connector.

Counterpoise kit included. Ensures low SWR, high efficiency.

All aluminum, stainless steel construction ensures years of excellent performance. *One kilowatt rated.*

18 foot Telescopic Fiberglass Mast with Tripod



MFJ-1919EX, $159.95.

***Put your antennas anywhere and get them up high with this super-strong* 18 foot telescoping fiberglass mast and heavy-duty steel MFJ-1919 tripod.**

QuickClamps™ easily collapses mast to 5 feet. Mast has thick 1/8 inch wall, .75 inch diameter top, 1.5 inch bottom. 15 lbs.

All tripods are black heavy-duty steel with braced triangle base, non-skid feet and mast lock.

MFJ-1918EX, $89.95. MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* Collapses to 3.8 feet. *QuickClamps™.* Mast has thick 1/8" wall, 3/4 inch top, 1 inch bottom. Weighs 6.5 lbs.

Tripods Only

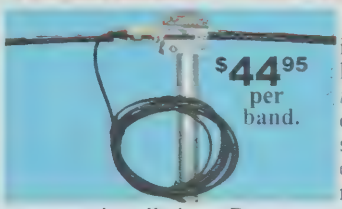
MFJ-1919, $89.95, *Large tripod.* Supports 100 lb. antenna. Built-in 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5Hx.5D feet. Triangle base spreads to 4.8 feet on a side. Weighs 9.75 lbs.

MFJ-1918, $49.95, *Smaller tripod.* Supports 66 lbs. 1 inch diameter mast extends 6 foot. Collapses to 3.2Hx.3D feet. Triangle base spreads to 2.75 feet. Weighs 6.75 lbs.

17 foot Stainless Steel Telescoping Whip

MFJ-1979, $59.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base. **MFJ-1977, $44.95** 12ft; **MFJ-1796, $39.95** 10ft **MFJ-1974, $34.95** 8ft; **MFJ-1972,** $14.95/4½ft

Single-band Rotatable *mini*-Dipoles



Use these inexpensive, lightweight, *isolated* mini-dipoles when space is limited for temporary or permanent installations. Rotate to null QRM/noise and to focus your signal. Coax choke balun, mast not included. For 40/30/20/17/15/12/10/6 Meters. Order **MFJ-22XX** (insert band in "XX") **$44.95.** 75/60 Meters, $49.95 each. Total length 14 feet. For mounting masts up to 1.25" OD.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What™* warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, M[illegible]

Add shipping.

Prices and specifications subject to change[illegible]

http://www.mfjenterprises.com *for instruction manuals, catalog, info*

Feeling isolated? get mobile!

IC-2730A 2m + 70cm
VHF/UHF FM Mobile Transceiver

Time-honored analog functionality

- 50/15/5 Watt Output*
- RX: 118–136.975MHz AM/AM-N, 137-174MHz and 375-550MHz FM/FM-N
- 1052 Memory Channels
- V/V, U/U simultaneous receive capability
- Large backlit display
- Independent band controls
- Weather channel with weather alert (US only)
- CI-V remote control capability (OPC-478UC required)
- Free CS-2730 PC programming software
- Bluetooth® Capabilities
  (Opt. UT-133 required for operation; VS-3 headset available)

ID-5100A 2m + 70cm Digital Transceiver

D-STAR ready Bluetooth®

Touch screen operation!

- 50/15/5 Watt Output*
- RX: 118 –174, 375–550MHz*
- 1000 Alphanumeric Memory Channels
- Dplus Reflector Linking
- Integrated GPS Receiver
- Bluetooth® Capabilities (Opt. UT-133 headset required)
- Free RS-MS1A Android™ Application
  (Performance may vary, depending on Android™ device.)

ID-880H 2m + 70cm Transceiver

D-STAR ready

Entry-class digital mobile

- 50/15/5 Watt VHF/UHF Output*
- FM, AM (Receive only), DV
- RX: 118–999.99MHz*
- 1052 Alphanumeric Memory Channels
- Free Programming Software!†

Information & Downloads

...or Hunker Down!*

ID-7850 HF / 50MHz Transceiver

Perfects HF Operation

- Limited Release of 150 units
- 1.2kHz optimized roofing filter
- New local oscillator (LO) design
  - 150dBc/Hz @ 10kHz offset
  - 140dBc/Hz @ 1kHz offset
- Improved phase noise
- Enhanced spectrum scope with mouse operation
- High resolution spectrum waterfall

ID-7600 HF / 50MHz Transceiver

USB Audio Functionality

- RX: 0.030–60.000MHz*
- 100 Watt Output (30W AM), Optional PS-126
- USB Port for CI-V Format, PC Control and Audio In/Out
- Dual Receive
- +30 dBm 3rd Order Intercept Point
- 3 Roofing Filters
- Selectable, "Build Your Own" IF Filter Shapes

IC-PW1 Linear Amplifier

- Wide frequency coverage with 1KW output
- Wide ALC adjustable range
- Compact body
- Detachable controller
- Automatic antenna built-in
- Automatic AC input voltage selector

#IcomAmateur

ICOM

CheapHam.com

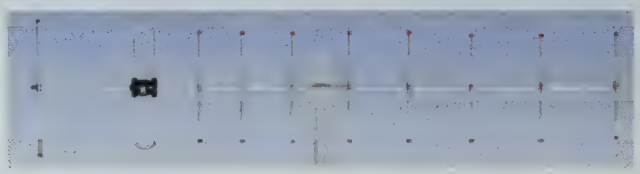
March Is Antenna Month !

S9 Antenna Closeout

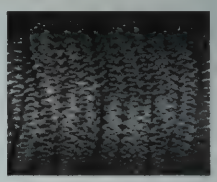
S9V18 - 6 through 20 meter 18 Ft. Vertical
Closeout Price $35
2 Pack $65
Limited Quantity

G5RV Starting at $37
Dipoles Starting at $29.95
Extra Saving on complete G5RV packages including rope and coax !

HTEK Yagis On Sale



7 element 2 Meter or 9 Element 220 mHz
$85 Each



Dacron Antenna Rope
UV Resistant
Break strength 780 lbs
500' Spool $50
100' $12.75

LDG Specials

All LDG Autotuners on Sale including the New RT-600

LDG YT-847
LDG YT-450
Autotuners for the FT-847 and FT-450
Closeout $99 Each
Limited Quantity

Special sale pricing on All Diawa Meters and Comet Antennas

SignaLink USB by Tigertronics Special Pricing

Includes Radio Interface Cable !
Makes it easy to operate WSPR, PSK31, SSTV, MT63, CW and More! Built-in sound card makes computer interfacing easy via the supplied USB cable.

Tram BR-6070
Dual Band
Vertical
On Sale
$69.95

WOUXUN

Dual-Band HTs Starting at $59
Dual & Quad Band Mobiles

New Heil PR-10 Package in Stock

HEIL SOUND

Heil Quality Discount Prices

New Heil Pro7 In Stock

New KG-UV8D Latest US Version $135

ALINCO

PayPal and Major Credit Cards Accepted

PayPal VISA BANK

Take Up to 6 Months to Pay Interest Free with PayPal

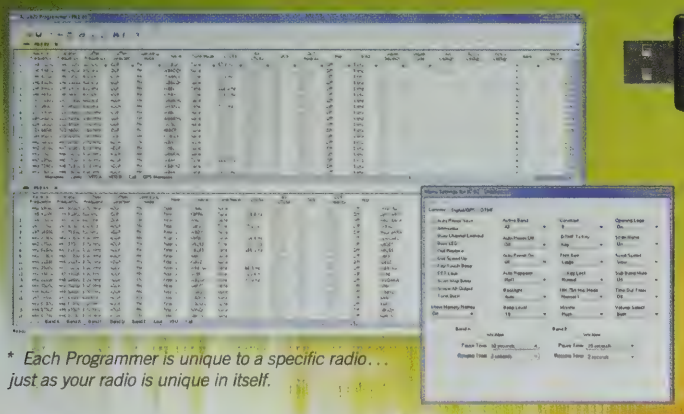
Discount Prices - Great Service - Fast Delivery - Global Shipping
Cheapham.com by Hometek LLC, 1575 Route 37 W, Unit 4, Toms River, NJ 08755
732-716-1600
Amateur Radio - CB - Marine - Parts - Pro Audio - Scanners - Test Equipment

Don't Miss Out on the Conversation.

Get on the Air Quickly! It's Sooooo Easy...

Easily explore ALL the features of your radio. Options you struggle to set from the face of the radio can be set up and saved in the Programmer. Software* programming kits available for 162 different radio models from many radio manufacturers.

RT SYSTEMS RADIO PROGRAMMING SOFTWARE* KITS



162
157 unique radio Programmers... and growing. Check for your radio model.

- Set Up All Memory Channel Details
- Easily Change Menu Items
- Read Current Radio Configuration
- Copy and Paste Between Files - Even Files for Different Radios
- Interface Directly to External Data Sources
- Import Data from CSV Files
- No Comport Setup
- Programming and Control USB Cables for Current and Past Radio Models

* Each Programmer is unique to a specific radio... just as your radio is unique in itself.

rt SYSTEMS
RADIO PROGRAMMING MADE EASY

800-476-0719 | www.rtsystems.com
Personal Assistance Mon.-Fri., 8:00-5:00 Mountain Time

Available Directly from RT Systems or Your Local Radio Dealer

Fully Automatic Solid State Amplifiers

THE Best Amplifiers in the World!

160 thru 6 Meter Coverage ■ Built-in, Dual Voltage Power Supply ■ Embedded Antenna Tuner ■ SO2R Compatible
Multiple Antenna Output Ports ■ Auto Band Switching ■ Full Break-in ■ Light Weight ■ Small Footprint

www.expertampsusa.com

E-Mail: expertampsusa@gmail.com ■ Telephone: (832) 612-7486

Expert Amps USA

3311 Hilton Head Court ■ Missouri City, TX 77459

Quicksilver Radio

Powerpole Products

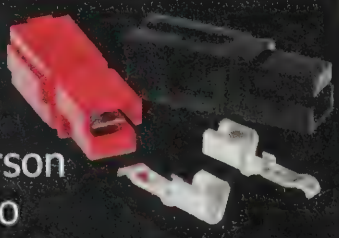
Ultimate Crimp Kit™

The Ultimate Powerpole & Coax Prep, Strip & Crimp Kit.
Only $129.73

Andy-Crimp Pro™ Deluxe Crimp Kit

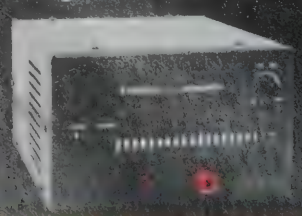
The Complete Powerpole Installation Kit.
Only $99.73

We Have More Powerpole Stuff than Anybody!



We carry only genuine Anderson Powerpoles. No cheap copies here.

35A Power Supply w/ Powerpoles



More power supplies on our website. qsradio.com

PWR-Blok™ Splitters

Feed any one of the connectors, and power your devices with the rest. Good for 40 Amps. Available in 4, 6, 8, 10 and 12 pole sizes.

GO-PWR Plus™ and GO-PWR Plus XL™

Portable power to go or backup in the shack. Includes Powerpoles, bright easy to read meter, and lighted switch. For u1 size (35 ah) and group 24 (80 ah) batteries.

Andy-Crimp Pro™

Best Powerpole crimper in the market!! Only $49.73

Sign up on our website for your **FREE** newsletter.
Ham Radio news, articles and special discounts.

www.qsradio.com

Cool Stuff for Hams

Quicksilver Radio

WATER-SHED™

Coax connector sealing tape. No adhesive, bonds to itself. UV, oil, salt, and chemical resistant silicone tape. Comes in 15 colors.
Only $6 ea. or $15 for a 3 pk.

Triple-Play™ Panels

Heavy duty panel mounted lighter socket, LED voltmeter and high current dual USB charger. Ideal for giving your Go-Kit or project a professional appearance.

Volt and Ammeters

Available in 2 sizes and 4 colors.

USB Microscope

Up to 500X magnification. A must for working on suface mount components.

Marine Grade Pulleys

Absolutely the best pulleys you can get for your antenna installation.

Wireless Relay

200' Range, We have single, four, and eight pole models.

Get All Your Ham Shack Essentials at Quicksilver Radio Products. Safe and Secure Ordering at:

www.qsradio.com

The Legend Continues

The TS-590SG

Back in 1973, Kenwood introduced the first affordable HF radio to the world, the legendary TS-520... 27 years later, the TS-570D and the TS-570S with 6 meters were by far the most popular HF and HF+6 transceivers on the market.

Be witness to the evolution of KENWOOD's pride and joy - the TS-590S HF transceiver - pushing performance and technology to its utmost limit, with the receiver configured to capitalize on roofing filter performance and IF AGC controlled through advanced DSP technology. Enter the TS-590SG. A new generation of high performance transceiver, with the type of high level response to meet DX'ers needs.

Don't be fooled by big boxes, high price tags, complex operation and broken promises. As Kenwood continues to build outstanding products with unparalleled performance and great value, it's no surprise Kenwood is rated as one of the leading choices for HF radios.

It's not too late to own an HF legend because we still build them today.

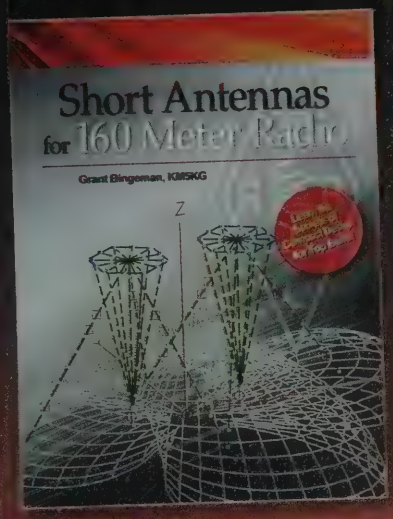
KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#49214



Short Antennas for 160 Meter Radio

Compact Antennas Possible on Top Band!

Short Antennas for 160 Meter Radio dares to discuss the possibility of smaller antennas for this intriguing band. Grant Bingeman, KM5KG, walks you through the theory behind innovative designs for relatively compact antennas. You'll learn how to enhance bandwidth, minimize loss, and employ other techniques to enjoy 160 meters with limited real estate.

Contents:

- Short Antenna Behavior
- A Better Way to Define Antenna Bandwidth
- Why Top-loading Can Improve Short Antenna Performance
- Top Hat Arrangements
- Inverted Cone Antennas
- Closed Antennas
- Antennas with Two Driven Elements
- T-shaped Antennas
- Inverted L-shaped Antennas
- Antennas with Four Driven Elements
- Spiral Antennas
- Small Horizontal Antennas
- Quadrature Feed Arrangements

...and more!

ARRL Order No. 5798
Special ARRL Member Price!
Only $19.95* (regular $22.95)
*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 1-888-277-5289 (US)

QST 2/2013

LNR PRECISION INC.

Introducing QRP Transceivers!

- Portable & Durable
- Small/Lightweight
- Tons of Features
- Perfect for SOTA

LD-5

FX-4a

Mountain Topper

LNR PRECISION INC.

PAR EndFedz Antennas

"They just work!"
Stealthy: Great for restricted residential areas!
Versatile: Install at home or take it with you!
Quality: Best in class!
www.LNRprecision.com

Radio Direction Finder
KN2C DF2020T Kit
Useful for 100~1000MHz
Map Plotting Program On Google Earth™ with GPS Data
On Sale $398
www.kn2c.us

Radio control en-/ decoder software / hardware
Bonito - RadioCom
RadioJet IF-radio
SDR Shortwave Receiver
General Distributor & Support
COMPUTER INTERNATIONAL, since 1989
St. Johns, MI 48879 – Phone 989 224 9080
qst@computer-int.com**www.computer-int.com

THE WIREMAN, INC
CERTIFIED QUALITY

800-727-WIRE (9473)
Still, going strong after 35 years! The "**Keywords**" for "Certified Quality" Wire, Cable, Connectors, Accessories,and customer service. See it all at www.thewireman.com
Tech Help: 864-895-4195 or info@thewireman.com
SOUTHWEST US? Call 405-376-9473
TOP WIREMAN dealer **CLEAR SIGNAL PRODUCTS**
www.coaxman.com • orders@thecoaxman.com

NATIONAL RF, INC.

Type 2-MQ Portaquad Antenna
A high-gain, full size 2-meter quad antenna designed for portable operations.
Visit our Web Site for more information.
www.nationalrf.com

2 x High Performance - RX 0.009 - 30 / 50 / 70 / 146 MHz HF IMD DR3 @ 2 kHz 105 dB TX - HF 200 W

Post Office of the World
K3FN QSL SERVICES

Custom QSL Service!

Envelope Mailing Systems
International Return Postage
Custom QSL Service

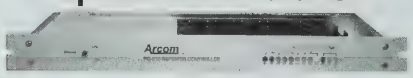
Envelope Mailers:
European or Normal Size – Covers & Return
Security Tinted – No Folding of the Return
European Size Pictured Above
$5.00 per Pack plus Shipping. (25 Envelopes per Pack)

Postage:
Return Postage for Over 100 Countries – Fair Pricing
Order On-line!

K3FN Custom QSL Service:
We Will QSL for You. Choose Your Category!
Details on Our Web

K3FN@aol.com
www.airmailpostage.com

Still Struggling With Your 20-Year-Old Repeater Controller?



More Power, More Features
Less Money

State-of-the-Art Repeater Controllers and Accessories

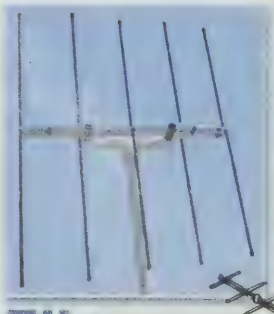
Arcom

Aurora, OR 97002 (503) 678-6182
www.arcomcontrollers.com

Tennadyne
Log Periodic Antennas
www.tennadyne.com

Call or Write for FREE Catalog!
P.O. Box 352,
Alto, MI 49302
Telephone:
616-622-4968

Cubex
Quad Antennas
www.cubex.com



Dual Band 2M/440 and other models

EmComm, Satellite work, long distance simplex and repeater use.

Elk Log-Periodic Antennas for the Radio Amateur
Antennas
925-727-3117
www.ElkAntennas.com

A practical guide to the revolutionary small computer

Raspberry Pi Workshop Manual

The perfect introduction to the fully functioning small computer. Written for those who are switching on their Pi for the first time, this manual guides you through the full process of setup and configuration. Includes various aspects of computing and programming, and provides a variety of recipes to demonstrate the acclaimed versatility of the Raspberry Pi's hardware and software.

ARRL Order No. 1007
Only $28.95*

*plus shipping and handling

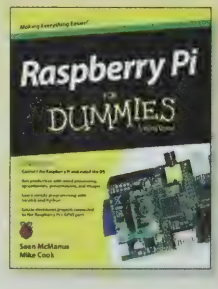
ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 1/2014

Embrace the exciting new technology of Raspberry Pi

Raspberry Pi for Dummies

With the invention of the unique credit-card sized single-board computer, the Raspberry Pi, comes a new wave of hardware geeks, hackers, and hobbyists who are excited about the possibilities of the Raspberry Pi. Get started in this exhilarating new arena with this fun and friendly book. You'll quickly discover how to download and install the operating system, use the installed applications, and much more.

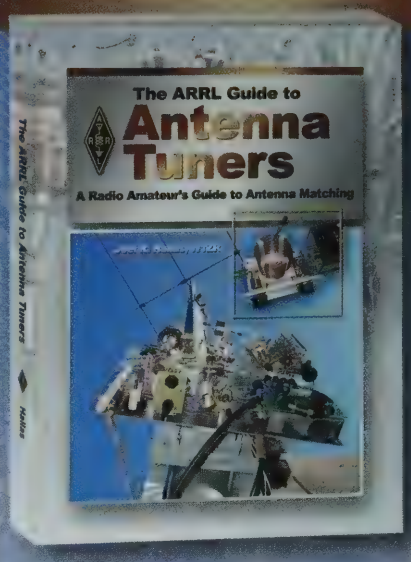


ARRL Order No. 2945
Only $24.99*

*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 1/2014



The ARRL Guide to Antenna Tuners

A Radio Amateur's Guide to Antenna Matching

By Joel R. Hallas, W1ZR

Explore the design, construction and applications of the different types of antenna tuners. Learn what type of tuner is needed in your station and where to install it for maximum improvement. This book will give you a better understanding of your antenna system and the way it can be enhanced through the selection and use of the appropriate antenna tuner.

Contents:

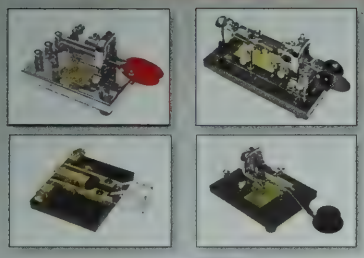
- Why Might I Need an Antenna Tuner?
- A Look at a Typical Configuration
- So Just What is an Antenna Tuner?
- Tuning an Antenna Tuner
- The Internal Tuner—How Does it Help
- An External Tuner at the Radio
- Transmission Lines and Loss
- Moving the Tuner to the Back 40
- Transmission Line Choices for Low Loss
- Balanced Versus Unbalanced Lines
- So What's a Balun, an Unun, a Choke?
- Balanced Antenna Tuners
- Antennas that Work Well with Tuners
- A Survey of Available Tuners
- Making Your Own Tuner

ARRL Order No. 0984
Only $22.95*
*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

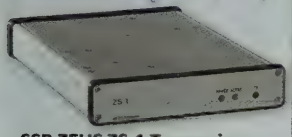
QST 3/2014

VIBROPLEX©



VIBROPLEX CW keys – 29 different models for the active CW operator – our 110th year. Iambic paddles, single lever paddles, straight keys, bugs, cables. We are the CW standard!

SSB Passion in high frequency



SSB ZEUS ZS-1 Transceiver – the top rated HF SDR in overall receiver performance. See June QST review! **$1699**

Perseus SDR Receiver – top end performance **$999**

SSB high-gain VHF preamps for 50, 144, 432 MHz. – Sequencers, switches, everything you need for high performance VHF operation.

spiderbeam high performance lightweight antennas

Spiderbeam is the world's top portable antenna system, also suitable for stealthy home use – ask us how. Portable and heavy duty yagis, telescoping fiberglass and aluminum push-up poles and masts from heights 33 to 85 ft. Made in Germany.

W7FG Vintage Manuals

Vintage Equipment Manuals Since 1992

- Highest quality reproductions
- Satisfaction Guaranteed
- Purchase online at: www.w7fg.com

www.vibroplex.com (865)309-5073

Everyone is Talking About...

EcoFlex™

Best Coax + Best Connectors

- Lower loss than LMR™ 400
- Flexible for easy install
- Direct burial
- All copper double shield, braid and foil
- 7 strand copper center
- Hardline-style SSB PL259's or genuine Amphenol connectors. No cheap crimp-ons or heat shrink!

	Amphenol PL259	SSB PL259	SSB N-style
3 ft Ecoflex 10	16.95	14.95	18.95
6 ft Ecoflex 10	20.95	18.95	22.95
15 ft Ecoflex 10	31.95	29.95	33.95
25ft Ecoflex 10	44.95	42.95	46.95
50ft Ecoflex 10	76.95	74.95	78.95
100ft Ecoflex 10	131.95	129.95	133.95
150ft Ecoflex 10	192.95	190.95	194.95
200ft Ecoflex 10	253.95	251.95	255.95

CUSTOM LENGTHS AVAILABLE

MADE IN GERMANY

VIBROPLEX©

www.vibroplex.com (865)309-5073

The DIY Magic of Amateur Radio

DVD Video, 8 minutes 32 seconds

The "Do It Yourself" movement is nothing new to Amateur Radio. For just over a century, "hams" have been working in basements and attics, taking things apart and putting them together in new ways for the fun of it. The enjoyment of seeing your own creation work—or even if it fails—always surpasses being a mere user of corporate products. Today's hams continue to use technologies in new and creative ways that can become the consumer products of tomorrow and, in the meantime, they have **FUN** doing it!

For more information, go to: www.WeDoThat-Radio.org

ARRL Order No. 6047
Only $10.95*
*plus $2.75 shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT *or call for a dealer near you.*
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 1/2015

Eagle One Vertical Antenna

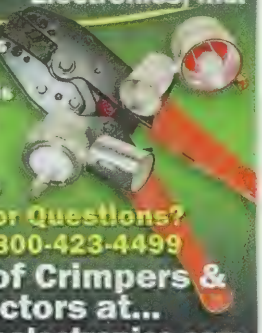
80-10M with most all tuners

- Extends to 32 ft, and down to 48"
- $10 return credit on PayPal and $10 discount on Credit card orders*.

*Offer expires April 30, 2015

S&G Engineering
212 Township Rd. 1134
Proctorville, Ohio 45669
740-886-6077
w8afxw8gms@yahoo.com
www.w8afx.com

Debco Electronics, Inc.

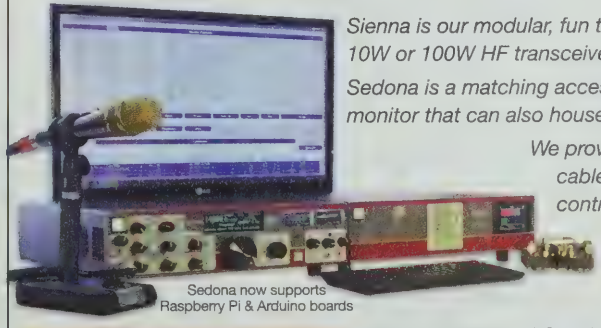


RF Patch Cables
Coax Crimping & Stripping Tools
RF Connectors
Powerpole Crimpers and Connectors

RF Connector Questions? Call Tom at 800-423-4499

Full Line of Crimpers & RF Connectors at...
www.Debcoelectronics.com

Ready for two high-performance kits?



Sienna is our modular, fun to build (soldering required!) 10W or 100W HF transceiver.

Sedona is a matching accessory with keypad and V/I monitor that can also house a PC and SDR.

We provide pre-loaded SMT, pre-built cables, assembled and tested controller, built-in test functions, clear step-by-step instructions, inspired kit packaging, and excellent support!

Sedona now supports Raspberry Pi & Arduino boards

DZ

The DZ Company, LLC • 710 Grove Ct. • Loveland, CO 80537
Toll free 877-HAM-SHACK (426-7422)
DZKit.com & ValleyHamShack.com

CABLE X-PERTS, INC.
Connecting You to the World...

1-800-828-3340

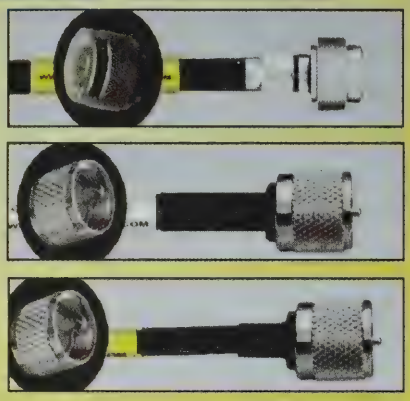
FOR PREMIUM ELECTRICAL PERFORMANCE FROM YOUR EQUIPMENT

See these fine loyal dealers for our quality products.
Private labeling at no charge.

HAM RADIO OUTLET (AES)

We take great pride in our work!

Custom or Ready-Made Coaxial Assemblies



Visit us on-line for cable selection and great prices.
Made in the USA
Serving You Since 1989

Limited Time – FREE Shipping on Orders of $100 or more.
Please mention this offer when ordering.

www.CableXperts.com

KENWOOD

Great Introductory Radio

The TH-F6A is incredibly small -just 2 5/16" x 3 7/16" x 1 3/16" in size and can fit in the palm of your hand. This great introductory handheld is an FM Triband with 5W of output power on 2m, 1.25m and 70cm! A separate wide band, all-mode receiver is built in. You won't miss a minute of scanning action from car races to the ballpark, or off to the airport Kenwood's TH-F6A has you covered.

Other attractive features include a built-in ferrite bar antenna for listening in on shortwave broadcast or your favorite local AM talk show, a lithium-ion battery and an easy-to-read LCD equipped with both contrast control and backlight.

www.kenwood.com/usa

Scan with your phone to download TH-F6A Brochure.

TH-F6A 144/220/440MHz FM TRIBANDER

ARES® Supplies

The Amateur Radio Emergency Service (ARES) consists of licensed amateurs who have voluntarily registered their qualifications and equipment, with their local ARES leadership, for communications duty in the public service when disaster strikes. These items are a great way to symbolize your commitment to Amateur Radio and the Emergency Service program.

- Polo Shirt
- T-Shirt
- Paracord Bracelet
- Sticker Red
- Sticker Black and Gold
- Decal Red
- Decal Black and Gold
- Patch Red
- Patch Black and Gold
- Pin
- Magnetic Sign
- Field Resources Manual
- All Weather Notebook

Order Online
www.arrl.org/shop
To connect with local ARES leadership, find training opportunities, and more visit:
www.arrl.org/ARES

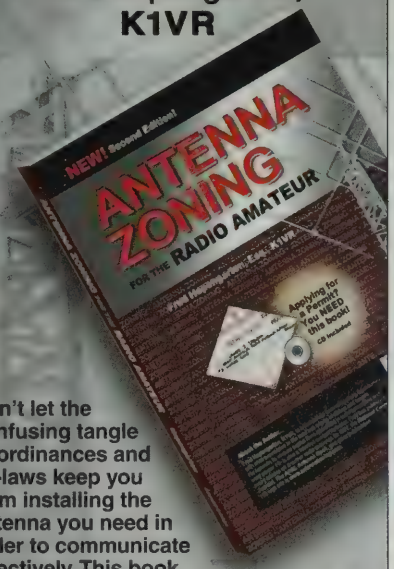
ARRL The national association for AMATEUR RADIO
SHOP DIRECT or call for a dealer near you
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 2/2015

Second Edition!

Antenna Zoning for the Radio Amateur

Fred Hopengarten, K1VR



Don't let the confusing tangle of ordinances and by-laws keep you from installing the antenna you need in order to communicate effectively. This book describes proven techniques and strategies that a ham and his or her attorney can use to obtain an antenna-structure permit. You'll learn to keep peace with the neighbors while enjoying ham radio!

Includes:

- Principles That Will Help You Win
- The Process in a Nutshell
- Your Winning Team
- Basic Preparations
- Getting to Know the Players
- Possible Objections
- Preparing the Permit Application
- Public Hearings—Your Big Moment in the Spotlight
- Deliberations and Decisions
- Now, Get the Permit and Build Your Antenna
- Awkward Post-Permit Situations
- Local and State Law, National Codes
- Drafting or Redrafting a Bylaw or State law
- Federal Law of Ham Radio Structures
- Other Federal Law
- Common Covenants and Restraints
- Canadian Laws

CD-ROM included!

ARRL Order No. 1192
Only $49.95*
*plus shipping and handling

ARRL The national association for AMATEUR RADIO®
SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 12/2011

NO ANTENNA, NO HAM RADIO!

ABR Industries · 8561 Rayson Rd. Ste A · Houston, TX 77080
www.abrind.com · 713-492-2722

Buy With Confidence

Built in our Houston, TX facility, guaranteeing quality control from start to finish.

RG213/U Mil-Spec w/PL259 Connectors.

Grounding Braid w/Ring Terminals.

LMR®400UF Type RG8/U Low Loss w/PL259 Connectors.

In stock at your nearby Ham Radio Outlet

LMR®240UF type RG8x Low Loss w/PL259 Connectors.

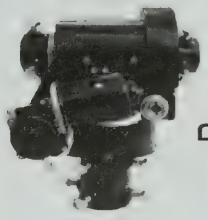
www.abrind.com

Visit our site for stock lengths, prices, technical data, & our stocking distributors.

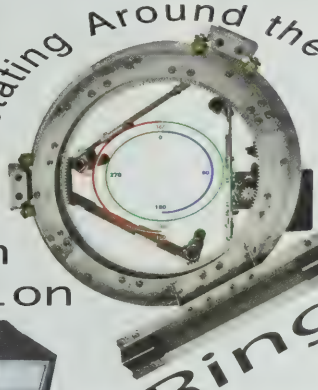
ABR INDUSTRIES™
American Built & Reliable

Made in USA

ALFASPID ROTATORS



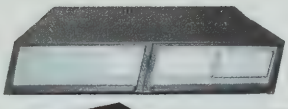
Rotating Around the World

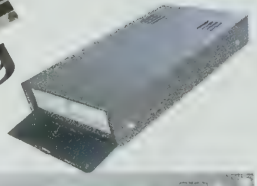


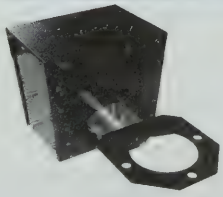
Azimuth Elevation

Azimuth

Ring







NATO Elevation

WWW.ALFARADIO.CA

High Torque, Self braking worm drive
USB, TCPIP (MD-0x), 720 degrees
Programmable limits, Simple wiring
12 - 24 Volt operation,
Small footprint for controller

ALFA RADIO LTD. 780 466 5779
sales@alfaradio.ca

Ham Ads

Please contact the **Advertising Department** at **860-594-0231** or **hamads@arrl.org** for further information or to submit your ad.

1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received December 16th through January 15th will appear in March *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0209 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than two ads in one issue. A last name or call must appear in each ad. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

QST Ham Ads on the Web Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

FRIEND OF BILL W?? 12:30 pm Eastern: HAAM Net Sat 14.290. Sun 14.340 and Mon-Fri 14.316 http://www.qsl.net/haam/

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621

RAINBOW AMATEUR RADIO ASSOCIATION Serving the international gay/lesbian/GLBT community since 1995. ARRL affiliated. Privacy respected. Active HF/VoIP nets, newsletter, chat room, message forums, cruises, Dxpeditions. Web Site: WWW.RARA.ORG. Information: 954-502-6969 PO Box 18541, Rochester NY 14618-0541.

WWW.THESIGNMAN.COM Club BADGES, call sign HATS, coffee MUGS, Vinyl letters & mag signs 877-SIGNMAN (744-6626)

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621

Property/Vacation/Rentals

Aruba Radio Rental www.p49v.com

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

FLORIDA 1/2AC NO CC&Rs! Build your antenna farm where it's warm. Large, double-lot in Silver Springs Shores Subdivision, Ocala, FL $25K 60HzEE@gmail.com 205-329-4445

HAWAII DX VACATION RENTAL STEPP-IR Antennas KH6RC. 808-929-7101 www.leilanibedandbreakfast.com

KH7Y QTH FOR SALE Enjoy DXing, Contesting from this new home, on 3 AC lot with 3,700 square FOOT HOME. Sweeping ocean views, excellent weather. Located ONE hour south of Kona. Main home has 3 bedrooms 2 full baths, plus large room that was used as an office. Large living room, dinning room and gourmet kitchen, with corion counter-tops. 500 square foot ham shack with a separate bath and 12x12 bedroom. 90 foot Rohn tower, 40 foot Rohn tower and a 40 meter four square. A fantastic radio location and a great place to live, play. $445k. Mahalo, Fred K6IJ contesthawaii@reagan.com

Lee Shaklee W6BH (Shaklee products) passed away in 2013. His 20 acre RADIO RANCH mountain top remote operation located in southern California is for sale. Contact Ted Halter at 951 316 6777 for further information.

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

VY2TT www.peidxlodge.com

Antique/Vintage/Classic

ANTIQUE WIRELESS ASSOCIATION. The organization for all enthusiasts of antique and historical radio! Publishes THE AWA JOURNAL, covering vintage ham gear, keys, telegraphy, contests, broadcast receivers, vacuum tubes, historical, technical articles, restoration, and much more. AWA produces the famous annual Rochester, NY meet. Maintains world-famous historical radio-electronics communications museum. Membership only $35/year USA, $40 elsewhere. Antique Wireless Association, PO Box 421, Dept. 1, Bloomfield, NY 14469. Check our Website: http://www.antiquewireless.org

Antenna MFJ1786 Loop. New in box. $275.00 plus actual shipping K4MMZ 772-545-9599

250 Novelty Transistor Radios selling entire collection 309-531-8641.

AM relic - 1930-40s AM transmitter, 6 chassis with Thordarson transformers and choke coils, Partial listing of tubes - Taylor T40, RCA 76, Arcturus 6A3. WA4DLR@Verizon.net

CLASSIC REPAIR - Specializing in Collins, Drake and other fine tube radios. Steve, 661-557-0014. n6hk@hotmail.com

CODE PRACTICE OSCILLATOR MUSEUM: http://www.n4mw.com

DISPLAY STANDS www.TubeDisplays.com

FOR SALE much sought after Halicrafters SX115 receiver $750.00. Kenwood TS820S needs work $450.00 802-388-6634

Insanely great six decades as ham www.kk4ww.com

"SOFT START YOUR RADIO from SIGTOMICS.com or (607) 785-7085 WA2LTD"

Visit THE SOUTHERN APPALACHIAN RADIO MUSEUM! - www.saradiomuseum.org 828-299-1276. Asheville, NC.

Vintage Repair www.mcveyelectronics.com/ham-radio

W4QCF MANUALS - 828-298-1847 http://www.w4qcfmanuals.com

QSLCards/Call Sign Novelties

CALLSIGN PLAQUES www.HamPlaques.com

DISPLAY YOUR AMATEUR LICENSE on the wall in your shack with this beautiful holder. Visit: www.fan--nanenterprises.com

ENGRAVING: Callsign/name badges by WØLQV. Send for price list. 8319 Marty St., Overland Park, Kansas 66212-1963. E-mail: w0lqv@arrl.net

Engraving, **QSL's**, Memo's, Stamps, Labels, Plaques since 1962, Full Service Printing. Samples. WA2WAO@CornerPress.com [425] 286-5952

CALL SIGN ID CARD with "Amateur Radio Active" logo. Deputypatch.com

Get **Top Quality Full Color UV-Coated QSL Cards** direct from the printer. Chester QSL Cards is now Star Cards, Inc. Call (800) 748-7089 for info or visit www.star-cards.net

HANDCRAFTED OAK CALL SIGNS www.oakcallsigns.com 314-605-4971, KCØSDV

QSLKIT – CardBoxes – Dividers – MORE www.HamStuff.com by W7NN

WWW.THESIGNMAN.COM 877-SIGNMAN (744-6626)

General

#1 AMATEUR CALLSIGN DVD! HamCall contains over 2,223,000 world-wide callsigns. 7,600,000 archive callsigns. Supported by most logging programs. Six FREE monthly Internet updates and HamCall.net Gold online access included. Check/Visa/MC/Discover.

73s: Join our hamradio social network! http://www.73s.com

ANTENNA COMPARISON REPORT: TRIBANDERS K7LXC & NØAX test Hy-Gain, KLM, CC, Bencher, Force 12, Mosley and others. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

ANTENNA COMPARISON REPORT: VERTICALS. K7LXC & NØAX test CC, Butternut, MFJ, Force 12, Diamond, Hustler, GAP and other. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

Antennas plus accessories equals FUN! http://HamRadioFun.com

AM relic - 1930-40s AM transmitter, 6 chassis with Thordarson transformers and choke coils, Partial listing of tubes - Taylor T40, RCA 76, Arcturus 6A3. WA4DLR@Verizon.net

ATTENTION YAESU-FT 102 18,000hrs, 25yrs, 800+ FT-102's Repaired. Have all parts. AM and Roofing Filters available. 25/hr, parts at cost. 954-961-2034 NC4L www.w8kvk.com/nc4l

BIGGEST on-line ham classifieds: http://swap.QTH.com

Bugbook Historical Microcomputer Museum www.microcomputermuseum.com

Cable Assemblies - APRS Link, Programming, PC Connect, Voice Com Control, Mobile Power - http://stores.ebay.com/Jabber-Electronics WE6G 480-905-8484

CQ DX. Well established WAS and DX Awards Net needs DX checkins. Please contact buddys70@gmail.com for more details if interested.

Help bring Ham Radio into classrooms: **HamRadioKids.com**

Kenwood TS-520 restoration and repair call Jimmy @ 856-447-3391 or email jl777@comcast.net

Custom Ham Maps by N1XFS!!! Customized azimuthal equidistant projection maps with beam headings and distances based on your QTH. Adds that special "wow" factor to your shack. Makes a great gift! Go to: **CustomHamMaps.com**

DIY ANTENNA MAST-better than telescopic. www.bend-gard.com

ELECTRIC RADIO MAGAZINE: America's popular monthly publication devoted entirely to vintage amateur radio, military equipment, restorations, and radio history. Samples $1. Electric Radio, P O Box 242, Bailey CO 80421, www.ERmag.com

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

"EVERYTHING FOR THE MORSE ENTHUSIAST." Morse Express. Keys, keyers, kits, books. 303-752-3382. http://www.MorseX.com

FAR CIRCUITS CD is available for $5.00 with orders or $8.50 including First Class shipping CD contains over 350 articles and additional project information.

For Sale: Ross Distributing 208-852-0830

"FOR SALE: CUSHCRAFT R6000 VERTICAL ANTENNA FOR 6,10, 12, 15, 17, 20 METERS. NOT USED OB, $200. JOE WHISNANT, W4RIQ, 1233 NEW CASTLE WAY, MARYVILLE, TN 37803. 865-977-9024."

Glen Martin Hazer Tower Transit Systems. Same day shipping. www.antennapartsoutlet.com

Ham Radio and Shortwave repair -any make HF/VHF/UHF- Bob, KF8IY 440-984-0084 (home) 440-653-1179 (cell) E: bobd@vasucom.com

CQ DX. Well established WAS and DX Awards Net needs DX checkins. Please contact buddys70@gmail.com for more details if interested.

HEATHKIT AMATEUR RADIO REPAIR by RTO Electronics, 601 E. 1st Street Calexico, CA 92231 269-468-7780. E-mail: hamtech@rtoham.com. www.rtoham.com

Help bring Ham Radio into classrooms: **HamRadioKids.com**

HOME of the world famous Yo-Yo Dipoles! http://HamRadioFun.com

ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit www.isotronantennas.com . wd0eja@isotronantennas.com 719/687-0650.

INRUSH CURRENT LIMITER for your radio or linear. SIGTOMICS.com or (607) 785-7085 WA2LTD

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

KB6NU.COM/STUDY-GUIDES/

KENWOOD AMATEUR RADIO REPAIR by K3TEN 609-846-5190 Email roy@k3ten.com Web http://www.k3ten.com TS-830, TS-820 And All Kenwood Hybrids, plus the TS-930's, TS-940's, TS950's, TS-2000s, TS-430s, TS-440s, TS-450s, TS-690s, TS-850s. TL-922 Amplifier Upgrades and Repairs.

Kenwood TS-590 base station, includes Astron RS-35M power supply, MC-60 mic, HS-5 headset, Signal Link, Par End-fed 20-40m antenna with two fiberglass 30-ft telescoping poles, coax, lightening arrestor. Used less than 15 hours, son needs money. $2800 firm + postage. Lloyd AE7VM 541-882-1088 PST or magnetservices@earthlink.net

Kenwood, Hybrid repairs and restoration 520, 520S, 520SE For more info please call **856-447-3391**

CALL SIGN ID CARD with "Amateur Radio Active" logo. Deputypatch.com

LEARN CODE by Hypnosis, www.success-is-easy.com 561-302-7731

LICENSE FRAMES - www.Gifts4Hams.com

MFJ 2990 - $175.00; MFJ 259B SWR Analyzer - $150.00; (631) 979-8198

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621 **FREE!!!** Ham Radio and other CD-Roms & Software disk catalog.

SELL Drake FS-4 Synthesizer $500 BO AS IS K0IC 712-379-3614

Kenwood TS-520 restoration and repair call Jimmy @ 856-447-3391 or email jl777@comcast.net

MicroLog-By-WA0H .. Easy to use logging program .. Free download .. www.wa0h.com

Microsoft Abandons XP - XpExtend provides critical security updates for Windows XP systems. Stop exploits before malware eats your machine! Visit http://xpextend.com

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

QRP KITS: Easy to build. Fun to use. www.breadboardradio.com

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

PUSHUP ANTENNA MAST -EXCEED 50.' Improved design. www.bend-gard.com

QST magazine copies in QST binders Details: www.synergiaglobal.com/qst

Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennapartsoutlet.com**

ROPE All kinds, types, including: antenna rope, hauling, gin pole. **FREE** Consultation. www.DavisRopeandCable.com <http://www.DavisRopeandCable.com **Veteran Owned, K1PEK 978-369-1738**

SMC ELECTRONICS - Surplus and refurbished electronic equipment including repair/replacement/ experimenter parts and accessories. Over 20,000 items in stock, including over 12,000 Service Manuals. www.smcelectronics.com

TOWER ACCESSORIES Gin Pole Kits - Antenna stand off brackets W9IIX.com 708-337-8172 www.w9iix.com

WANTED: Good 8236 Pentode Electron Tubes for my transmitter. What price do you need and how many can I get? Dave at 2817815955 or fullerphone7150@yahoo.com

WANTED A Ten-Tec scout e: ve1bc@rac.ca

WE BUY/SELL RADIOS. **#1 IN ESTATES** – www.recycledradio.com (603) 942-7173

www.SecondHandRadio.com Electronic or Electrical - find it here, sell it here.

WWW.THESIGNMAN.COM Hats, license plates & frames, decals & gifts

W9SS selling my almost complete collection of all 1926-2015 ARRL annual Handbooks. For more details, email w9ss@hotmail.com

"YOU CAN check spots, log contacts: www.dxtreme.com"

AMSAT – WHO DECIDES THE FUTURE OF AMATEUR RADIO IN SPACE? YOU DO! For more than 30 years AMSAT has pioneered dozens of spacecraft that have brought operating enjoyment to thousands. Your membership in AMSAT will support exciting projects planned for launch in the years to come. In addition, you'll receive the bimonthly *AMSAT Journal* and substantial discounts on software distributed by AMSAT. Join now! From the US call toll free at: (888)-322-6728. From all other locations call 1-301-822-4376. Or visit the AMSAT Web site at www.amsat.org. AMSAT®, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

ALL ELECTRONICS CORPORATION

BREADBOARD POWER SUPPLY

Plugs into solderless breadboards and provides regulated 5V and/or 3V power to the rails. Other functions: an on-off switch, power indicator lamp, USB port & headers for 3V and 5V power taps. Max. output: 700mA. Requires a 6.5V -9V power supply with 2.1mm coax plug (not included). **CAT# MB-PS** $6.75 ea.

5 VDC REED RELAY

Elec-Trol #BBS1C05A10. SPDT SIP. **CAT# RLY-496**

10 for 85¢ each

$1.00 each

FLOAT SWITCH

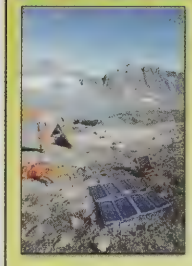
Liquid level float switch for sensing rising or falling liquid levels. Integrated 10K ohm NTC thermistor allows monitoring of liquid temperature as well. Threaded 13/16" male Nylon stem. 2.4" long from hinge to end. **CAT# FLW-1**

$6.75 each

10 for $6.25 each
100 for $5.90 each

1-800-826-5432
www.allelectronics.com

Portable and Custom Stand-Alone
Solar Power Systems



Folding Solar Panels
Portable Solar Powered Lithium Battery Packs
Thin Film Solar Panels
QRP Power Systems
Solar Power Components
Back-up Emergency Power Systems

Telephone Customer Tech Support
Portable/Field Day Solar Power Solutions
Custom Home/Commercial Power Systems

We guarantee that our products will work for your application and we guarantee your satisfaction with our products.

www.ctsolar.com
No Power.....No Problem

Call us at 772-233-8485 or visit us at www.ctsolar.com

Real Kits, True Challenge

YouKits®

New! DP-1 QRP Digital Power and SWR Meter
Assembled and ready to use. Very low power consumption.
Only $129

New! Youkits EK1A CW Transceiver Kit
Only $149

New! Youkits MT1 QRP Manual Tuner
Kit version $69
Assembled version $89

TJ5A Assembled and Tested, Kit in Stock

Only $399

New! FG-01A 1-35Mhz Antenna Analyzer Assembled and Tested

Only $199

FG-01 Antenna Analyzer New Version!

- 1-72Mhz automatic antenna analyzer
- 10 MEM, SWR and impedance scan curve
- Assembled tested.

TJ2B New 2015 Version, with CW Function and S Meter
- Assembled, tested.

New! SWR Indicator!
Youkits HB-1A MK2 2 Band CW Transceiver
- TX: 7.0-7.3MHz 14.0-14.35MHz, RX: 5-16MHz
- Assembled, tested.

Only $219

New! Youkits HB-1B MK2 4 Band QRP CW Transceiver

- QSK-full break-in, 60m band USB RX, IF filter adjustable.
- TX: 3.5-4MHz,7-7.3MHz, 10.1-10.15MHz, 14-14.35MHz, RX: 3.2-16MHz SSB,CW
- Output:12V 3-4W, 13.8V 4-5W
- Assembled, tested.

US Distributor: TEN-TEC, Inc., 1148 Wagner Dr., Suite 202, Sevierville, TN 37862, 1-800-833-7373
Canadian Distributor: Durham Radio Sales, 10-1380 Hopkins St., Whitby, ON L1N2C3, 1-888-426-1688
UK Distributor: Waters & Stanton PLC, Spa House, 22 Main Road, Hockley, Essex. SS5 4QS. UK. +44(0)1702 206835

www.youkits.com

FERRITES FOR HAMS

Ferrite – Toroids, Slip-on, Snap-on
Mix 31, 43, 61, 77 for Baluns/Ununs, RFI/EMI
Quantity pricing for Clubs, DXpeditions

Antenna Balun/Unun - kits or assembled
1:1, 2:1, 4:1, 9:1 for dipoles, verticals, G5RV, loops, OCF, end fed, NVIS, quad, yagi antennas

RFI Kits - home, mobile, or portable operation
Free Tip Sheet to cure RFI, reduce radio noise, work more DX and keep your neighbors happy!

Palomar-Engineers
www.Palomar-Engineers.com
760-747-3343
We Ship Worldwide

BATTERIES AMERICA

Mar'15 specials. Call 800-308-4805; ONLINE @

www.batteriesamerica.com

For YAESU VX-5R, 5DR/GR, FT10R/E (Sporting BELT CLIP 3.6.3.9):

FNB-102Li Li-ION batt. 7.4v 2000mAh $45.95

For YAESU FT-897, 897R, 857D "BackPacker" Radios:

FNB-78 Ni-MH battery 13.2v 4500mAh $89.95

For YAESU-Vertex VX-5R/s, VX-6R, VX-7R/b, VX-7Rb, VXA-700:

FNB-80Li Li-ION battery 7.4v 1600mAh $44.95

E-DC-5BA DC Power & Charge cord (NEW) $19.95

NC-72BA AC-DC Power / Battery Charger $17.95

For YAESU-Vertex FT-60R,250,270R; VX-110,120,150,170,177,180,210

FNB-83xe eneloop 7.2v 2100mAh $49.95

For YAESU-Vertex FT-817 (PRE-CHARGED). (E-DC-5BA DC cord $19.95)

FNB-72xe eneloop 9.6v 2100mAh $49.95

For YAESU-Vertex VX-1R (RARE, has custom-designed PCB.)

FNB-52Li Li-ION battery 3.7v 750mAh $29.95

For YAESU-Vertex FT-50R,40R,10R; VXA-100. (E-DC-5BA: $19.95)

FNB-41xs Hi-Watt battery 9.6v 1450mAh $52.95

For YAESU FT-11R, FT-41R, FT-51R, etc. (HIGH POWER battery):

FNB-38xh Hi-Watt battery 9.6v 1450mAh $52.95

For YAESU FT-530,76,26,416,415,816: (E-DC-5BA: DC Pwr cord $19.95):

FNB-25x Ni-MH battery 7.2v 1200mAh $32.95

FBA-12 6-cell AA Battery Case $22.95

FNB-27xs Hi-Watt battery 12.0v 1450mAh $49.95

For YAESU FT-411, 470, 73R, 33R, 23R etc: (WC-12 wall charger $12.95):

FNB-12xh Ni-MH batt. 12v 1250mAh $39.95

FBA-17 6-cell AA Battery Case $19.95

For ICOM IC-92AD (D-STAR): (CP-11L: DC Pwr/Chg cord $19.95)

BP-256 Hi-Watt LI-ION batt. 7.4v 1620mAh $44.95

For ICOM ID-31A, ID-51A (D-STAR radios): NEW!

BP-272Li LI-ION Battery 7.4v 2000mAh $52.95

For ICOM IC-T90A/E, IC-91A, IC-91AD, IC-80AD (D-STAR), etc:

BP-217 5W LI-ION battery 7.4v 1600mAh $44.95

CP-11L DC Power & Charge Cord (fits IC-92AD too) $19.95

For ICOM IC-V8,V82, U82, F3, F40GS/GT, F30,40GS/GT,A24,A6, etc

BP-210NEX eneloop NiMH 7.2v 2100mAh $49.95

For ICOM IC-T8A/E/HP; T81A/E; A23,A5: (WC-A1C Wall Chrgr $12.95)

BP-200XL Hi-Watt battery 9.6v 1450mAh $59.95

BP-197h 6-cell AA Battery case (Hi-Watt) $29.95

For ICOM IC-W32A/E, T7A/E, T7H, 21A/E, T22A, T42A, W31A/E:

BP-173x Hi-Watt battery 9.6v 1450mAh $59.95

BP-170L 6-cell AA Battery case (Hi-Watt) $25.95

For ICOM IC-2/24S4T, W2A, 24AT, 24S/RA, Rx: (BC-105A: $22.95)

BP-83xh Ni-MH battery 7.2v 2200mAh $39.95

For ICOM IC-2/02/03/04AT,2/4GAT etc; Radio Shack HTX-202/404:

IC-8 8-cell AA battery case (w/ Charge Jack) $24.95

BP-202e Eneloop- Rad. Sh. 7.2v 2100mAh $39.95

For KENWOOD TH-D72A/E: (CP-KE12: DC Pwr & Chg cord: $19.95)

PB-45L Li-ION batt (NEW) 7.4v 2000mAh $44.95

For KENWOOD TH-F6A, TH-F6E, TH-F7: (CP-42L: DC cord: $9.95)

PB-42L Li-ION battery 7.4v 2000mAh $44.95

PB-42XL Li-ION battery 7.4v 4000mAh $59.95

EMS-42K Drop-in Rapid Charger for PB-42L/XL $49.95

For KENWOOD TH-G71A, TH-D7A,AG/E: (CP-39: DC Pwr cord $9.95)

PB-39h Hi-Watt Ni-MH batt. 9.6v 1450mAh $54.95

BT-11h 6-cell AA Battery Case (Hi-W) $24.95

For KENWOOD TH-79A/E, 22A/E, 42A/E etc: (CP-79: DC cord $9.95):

PB-34xh Hi-Watt NiMH batt. 9.6v 1200mAh $39.95

For KENWOOD TH-78A/E, 48A/E, 28A/E, 27A/E: (CP-17: DC cord $9.95)

BT-8 6-cell AA Battery Case $14.95

PB-13xh Ni-MH battery 7.2v 1800mAh $39.95

For KENWOOD TH-77A/E,75A/E,55A/E,45AT/E,45AT,26A/E,25A/E:

PB-6x Long Life Ni-MH battery 7.2v 1600mAh $36.95

For KENWOOD TH-205A/E,215A/E,225A,315A: (Wall Charger $12.95)

PB-2 Std. Ni-Cd batt. 8.4v 800mAh $29.95

For KENWOOD TR2500, TR7600: (Wall Charger $12.95)

PB-25-26 Std. Ni-Cd batt 8.4v 800mAh $29.95

For ALINCO DJ-V5, DJ-V5TH: (CP-46: DC Pwr/Chg Cord $9.95)

EBP-46xh Ni-MH batt. 9.6v 1450mAh $52.95

For ALINCO DJ-193/HP/R, 193,196,446,493,496,596: (DC cord $9.95)

EBP-48h Hi-Watt battery 9.6v 2000mAh $44.95

For ALINCO DJ-G5T/TH,V7A,19/T,19T,V7T/TH: (DC Pwr Cord $9.95)

EBP-36xh Hi-Watt batt. 9.6v 1450 mAh $52.95

For ALINCO DJ-280T, DJ-582, DJ-480T, DJ-280T, DJ-180 etc:

EDH-11 6-cell AA Battery Case $22.95

EBP-20x Ni-MH battery 7.2v 2000 mAh $32.95

For ADI AT-600, REALISTIC HTX-204 (Wall Charger is $12.95):

ADI-600x Hi-Watt battery 12.0v 1200mAh $44.95

For STANDARD C228,C528,C558; ADI MT-20T, MT-40T etc:

CNB-152xh NiMH batt. 12.0v 1200mAh $45.95

CBP-888 8-cell AA Battery Case (Hi-WATT) $28.95

NEW! BC-MQN10A Smart Charger & 4xAA or 4xAAA eneloops! $19.95 pkg

(1) Quick Charger for AA & AAA Ni-MH; charges 2 or 4 at a time. Includes SANYO eneloop cells

(2) Plugs right into wall outlet. Choose Charger with 4 x AA or 4 x AAA eneloop Ni-MH cells.

(3) Safe, quick 4 - 5 hr chg with auto shut-off.

(4) Easy-to-read LED charge status indicators.

SANYO eneloop AA cells, PRE-CHARGED $13.95/pack of 4

Quick! Online, Mail, E-mail, Phone, or Fax w/ MC, VISA, DISC, or AMEX

BATTERIES AMERICA- 8845 S. Greenview #2, Middleton, WI 53562

Order online, or call us at 1-800-308-4805

Fax: 608-831-1082. E-mail: sales@batteriesamerica.com

Advertising Department Staff:

Debra Jahnke, K1DAJ, Sales Manager, Business Services
Janet Rocco, W1JLR, Account Executive
Lisa Tardette, KB1MOI, Account Executive
Diane Szlachetka, KB1OKV, Advertising Graphic Design
Zoé Belliveau, W1ZOE, Business Services Coordinator

QST Index of

ABR Industries™ – www.abrind.com 161
Advanced Specialties – www.advancedspecialties.net 144
AeroStream – CommRadio Division – www.commradio.com ..... pull-out 135
Air Boss Antenna Launcher – www.kr4loairboss.com 124
Airmailpostage.com – www.airmailpostage.com 158
Alinco – www.alinco.com 23
All Electronics Corp. – www.allelectronics.com 163
Alfa Radio LTD – www.alfaradio.ca 161
Alpha Delta Communications – www.alphadeltacom.com 128
Alpha Node Hub – www.alphanodehub.com ..... pull-out 133
Amateur Electronic Supply, LLC – www.aesham.com 115, 117
Ameritron – www.ameritron.com 17, 127
Applied Engineering Science, Inc. – www.aes-rf.com 123
Arcom Communications – www.arcomcontrollers.com 158
Array Solutions – www.arraysolutions.com 18, 118
ARRL – www.arrl.org ..... 12, 112, 114, 116, 118, 119, 121, 122, 123, 124, pull-out 130, pull-out 131, pull-out 133, pull-out 134, pull-out 135, 138, 140, 144, 148, 157, 158, 159, 160, 161, 166
Balun Designs LLC – www.balundesigns.com ..... pull-out 133
Batteries America – www.batteriesamerica.com 164
bhi Ltd – www.bhi-ltd.co.uk 124
Buckmaster Publishing – hamcall.net 138
Buddipole Antennas – www.buddipole.com ..... pull-out 131
Cable X-Perts, Inc. – www.CableXperts.com 160
CheapHam.com – www.cheapham.com 152
Computer International – www.computer-int.com 121, 157
CTSolar – www.ctsolar.com 163
Cubex – www.cubex.com 158
Cushcraft – www.cushcraftamateur.com 2
Dayton Hamvention/ARRL Expo 2015 – www.hamvention.org 122
Debco Electronics, Inc. – www.Debcoelectronics.com 159
Diamond Antenna – www.diamondantenna.net 11
DX Engineering – www.DXengineering.com 110, 111
DZ Company, LLC. The – www.dzkit.com 159
Elecraft – www.elecraft.com 19, 21, 121
Electronic Products Design, Inc. – www.epd-inc.com 144
Elk Antennas – www.ElkAntennas.com 158
Expert Amps USA – www.expertampsusa.com 153
Expert Linears America, LLC – www.ExpertLinears.com 119
EZ Hang – www.ezhang.com ..... pull-out 133
FlexRadio Systems – www.flex-radio.com 25
Force 12/InnovAntennas – www.Force12Inc.com ..... pull-out 131
Gap Antenna Products, Inc. – www.gapantenna.com 124
Global TSCM Group, Inc. – www.kn2c.us 157
Green Heron – www.greenheronengineering.com ..... pull-out 135
Ham Ads – www.arrl.org/ham-ad-listing 162, 163
Ham Radio Deluxe – www.ham-radio-deluxe.com 126
Ham Radio Outlet – www.hamradio.com 106, 107, 108, 109
Hammond Mfg. Co. – www.hammondmfg.com 118
HamTestOnline – www.hamtestonline.com 121
Hilberling – www.hilberling-usa.com 157
Hy-Gain – www.hy-gain.com 10, 125
ICOM America – www.icomamerica.com 150, 151
International Radio INRAD – www.inrad.net 144
Intuitive Circuits, LLC – www.icircuits.com 124

Your Customers are Reading...QST!

If your company provides products or services of interest to our Members, please contact the ARRL Advertising Department today for information on building your business.

Support those who support ARRL! Please patronize our ARRL Advertisers.

Contact Information:

Toll Free: 800-243-7768
Direct Line: 860-594-0207
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

Kenwood Communications – www.kenwoodusa.com ..... Cover IV, 29, 156, 160
Kuhne electronic – www.kuhne-electronic.de ..... pull-out 135
LDG Electronics – www.ldgelectronics.com ..... Cover III, 6, 7
LNR Precision EndFedz – www.LNRprecision.com 157
M² Antenna Systems, Inc. – www.m2inc.com 123
Main Trading Company – www.maintradingcompany.com 116
Mayberry Sales & Service, Inc. – www.mayberrys.com 138
MFJ Enterprises – www.mfjenterprises.com 137, 139, 141, 143 145, 147, 149
Mosley Electronics – www.mosley-electronics.com ..... 128, pull-out 131, pull-out 133,138
N4PY Software – www.n4py.com 121
N4XM, XMatch Antenna Tuners – http://n4xm.myiglou.com 144
National RF – www.NationalRF.com 157
NCG Company – www.natcommgroup.com ..... 3, pull-out 132
Palomar Engineers – www.Palomar-Engineers.com 163
Personal Database Applications – www.hosenose.com 138
Portable Rotation – www.portablerotation.com ..... pull-out 133
Powerwerx – www.powerwerx.com 167
Pro Audio Engineering – www.proaudioeng.com 121
Quicksilver Radio Products – www.qsradio.com 154, 155
R&L Electronics – www.randl.com 113
Radio City – www.radioinc.com 140
Radio Club of JHS 22 NYC – www.wb2jkj.org 120
Radio Works – www.radioworks.com 121
RemoteHamRadio.com – www.remotehamradio.com 8
RF Concepts, LLC. – www.rfconcepts.com 26, 120
RF Parts Company – www.rfparts.com 165
RMItaly.US – www.rmitaly.us ..... pull-out 130
RT Systems – www.rtsystems.com 153
S&G Engineering – www.w8afx.com 159
SEA PAC/NW Division Convention – www.seapac.org 144
Spiderbeam-US – www.spiderbeam.us 159
SSB-Electronic– www.vibroplex.com 159
SteppIR Antennas – www.steppir.com 28
Tac-Comm – www.tac-comm.com 144
Telewave, Inc. – www.telewave.com ..... pull-out 130
Tennadyne – www.tennadyne.com 158
Ten-Tec – www.tentec.com 27
Ten-Ten International Net, Inc. – www.ten-ten.org 138
TERA – www.tera.co 167
Texas Towers – www.texastowers.com 168
Tigertronics – www.tigertronics.com 119
Timewave Technology, Inc. – www.timewave.com ..... pull-out 136
Top Ten Devices, Inc. – www.qth.com/topten/ ..... pull-out 133
Vari-Ten LLC. – www.antennatensioner.com 121
Vibroplex – www.vibroplex.com 159
Vintage Manuals – www.vintagemanuals.com 159
W5YI – www.w5yi.org 142
Warren Gregoire & Associates – www.warrengregoire.com 138
West Mountain Radio – www.westmountainradio.com 22
Wireman – www.coaxman.com 157
Yaesu USA – www.yaesu.com ..... Cover II, 1
YouKits – www.youkits.com 163

QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
April 2015	Monday, February 16, 2015	Thursday, February 19, 2015
May 2015	Monday, March 16, 2015	Thursday, March 19, 2015

For links to the Web sites of all ARRL advertisers, visit www.arrl.org/ads/adlinks.html

From MILLIWATTS To KILOWATTS℠
More Watts per Dollar™
Transmitting & Audio Tubes
Eimac · RF · Taylor Tubes
COMMUNICATIONS
BROADCAST
INDUSTRY
AMATEUR
Immediate Shipment from Stock

3CPX800A7	4CX1000A	810
3CPX1500A7	4CX1500B	811A
3CX400A7	4CX3500A	812A
3CX800A7	4CX5000A	833A
3CX1200A7	4CX7500A	833C
3CX1200D7	4CX10000A	845
3CX1200Z7	4CX15000A	6146B
3CX1500A7	4CX20000B	3-500ZG
3CX3000A7	4CX20000C	3-1000Z
3CX6000A7	4CX20000D	4-400A
3CX10000A7	4X150A	4-1000A
3CX15000A7	572B	4PR400A
3CX20000A7	805	4PR1000A
4CX250B	807	...and more!

Se Habla Español • We Export

Phone: 760-744-0700
Toll-Free: 800-737-2787
(Orders only) 800-RF PARTS
Website: www.rfparts.com
Fax: 760-744-1943
888-744-1943
Email: rfp@rfparts.com

VISA · MasterCard · Discover Cards

RF PARTS COMPANY

Facing the Challenge of Spectrum Defense Together...

As a community, Amateur Radio enthsiasts share a passion for the greatest hobby in the world. And, whether you operate for public service, competition pursuits such as DXing or contesting, or simply for the joy of connecting with hams in other parts of the world, we share the use of frequencies designated for Amateur Radio use.

But Amateur Radio faces a huge challenge — every day, technology-related industries attempt to acquire spectrum for their control and profit. We have faced these challenges before — and together we have met them. With your support, ARRL staff and volunteers maintain constant vigilance, both at home and abroad, to ensure that our bands remain open and clear. Your continuing financial support is vital to our maintaining our watchfulness. **Please give generously to the Spectrum Defense Fund today!**

ARRL 2015
SPECTRUM DEFENSE FUND

Make your gift the easy way!
Visit **www.arrl.org** and click the DONATE NOW button. Use the "Additional Comments" box to indicate if you would like a 2015 Spectrum Defense Fund certificate, mug or pin.

NEW! 2015 Spectrum Defense Mug and Pin!
Introducing the second edition in a five-year series, 2014-2018 (featuring the color of ARRL's five pillars: Advocacy, Membership, Public Service, Education and Technology).

Make a gift of $50 to the Spectrum Defense Fund and receive our *newly designed* 2015 Spectrum Defense pin. Make a gift of $100 or more and receive both a mug and pin!

For more information, contact:

Lauren Clarke, KB1YDD
Development Manager
ARRL
225 Main Street
Newington CT 06111-1494
Telephone: 860-594-0348
Email: lclarke@arrl.org

TERA

The new standard in affordable two-way communications

TR-590

- VHF/UHF Dual Band
- 200 Memory Channels
- True Dual RX (V+V, U+U, V+U)
- Dual Volume Controls
- 2 Year Warranty*

TR-500

- VHF/ UHF Dual Band
- 16 Memory Channels
- Built-in Voice Announce
- Simple Operation
- 2 Year Warranty*

WWW.TERA.CO/QST

* All radios are FCC part 90 certified. Two year limited warranty on radio body, 6 month limited warranty on included accessories.

Universal

YOUR NUMBER FOR SAVINGS (800) 272-3467

www.texastowers.com

- Great Gear
- Great Deals
- Great Service

TEXAS TOWERS

Savings As Big As Texas!

B-18 SERIES

Light duty aluminum self supporting towers. Five models ranging from 30 to 50 feet, and supporting up to 12 square feet of antenna wind load.

B-26 SERIES

Medium duty aluminum self supporting towers. Thirteen models ranging from 30 to 90 feet and supporting up to 34.5 square feet of antenna wind load.

B-30 SERIES

Heavy duty aluminum self supporting towers. Nineteen models ranging from 40 to 100 feet, supporting up to 34.5 square feet of wind load.

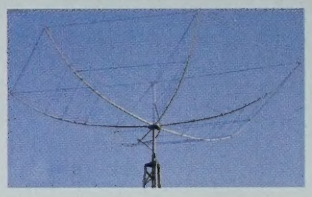
CALL FOR MORE INFO!

ROHN

25G	$119
25AG2/25AG4	$189/239
AS25G/AS455G	$65/119
BPC25G/BPH25G	$69/279
BAS25G/BPL25G	$299/199
EP2534-3/5	$49/65
GA25GD/GA45GD	$159/189
GAC3455	$139
GAR30/GAS604	$45/69
HB25AG/HB25BG	$119/129
SB25G/SB25G5	$79/109
SBH25G	$249
TB3/TB4	$159/179
TRT36/TRT60	$59/69
TRTAG2/9H50	$219159
WP25G/WP45G	$149/159

IIX EQUIPMENT

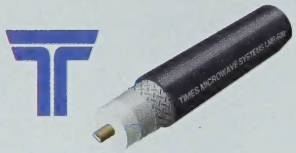
BP1X Snatch Block	$149
GP21X Clamps/Kit	$279/319
GP31T Clamps/Kit	$329/409
GP-81 Clamp/Kit	$239/299
GP-UPS Gin Pole	$209
GPP Gin Pole Pulley	$109
SO1X Stand-Off	$199
SO4 Stand-Off	$169
SO5-6" Stand-Off	$99
SO5-26" Stand-Off	$139



TEXTENNA

TexHex 5-Band $589

Provides broadband (typical VSWR <1.5:1) coverage of 10/12/15/17/20m. Optional 6m kit. Improved heavy-duty mounting plate fits masts up to 2" OD. Pre-tuned elements, easy to install. In stock!



TIMES LMR COAX

Lower loss than traditional coaxes without the water displacement problems common to 9913 and 9086 types.

LMR-200	$.65/FT.
LMR-200 Ultraflex	$.85/FT.
LMR-240	$.69/FT.
LMR-240 Ultraflex	$.89/FT.
LMR-400	$.89/FT.
LMR-400DB	$1.09/FT.
LMR-400 Ultraflex	$1.39/FT.
LMR-600	$1.59/FT.
LMR-600 Ultraflex	$2.49/FT.

MORE LMR CABLES IN STOCK

DAVIS RF

COAX - MADE IN USA

All have high-quality non-contaminating outer jackets.

RG-58C/U	$.29/FT.
RG-8X Mini	$.29/FT.
RG-213/U	$.79/FT.
BuryFlex	$.89/FT.
Belden 9913F7	$1.29/FT.

COMET ANTENNAS

CAA-500 Analyzer	$439
CHA-250B	$389
GP-3/GP-6	$99/149
GP-9/GP-9N	$189/189
GP-15/GP-98	$169/189

DIAMOND ANTENNAS

X-30A/X-50A	$69/99
X-200A/X-300A	$129/139
X-510HDMA/HDNA	$199
X-3200A/X-6000A	$179

MFJ

MFJ-259C Analyzer	$249
MFJ-269C Analyzer	$359

GLENMARTIN

H2 Hazer	$609
H3 Hazer	$459
H4 Hazer	$589
RT-424 Roof Tower	$319
RT-832 Roof Tower	$469
RT-936 Roof Tower	$779
RT-1832 Roof Tower	$1029
RT-2632 Roof Tower	$1709

texcom RF PRODUCTS

Crimp Kit $99

Tool kit to prepare and crimp RF connectors for .100", .200", .240" and .405" diameter coax cables, including LMR-100, LMR-200, LMR-240, LMR-400, RG-8/8X/58/213, BuryFlex, 9913, 9086, 9096 and other similarly sized cables. With rugged plastic storage case.

Crimp Kit Plus $109

Same as the Crimp Kit, but also includes dies for Anderson PowerPole™ connectors.

WE HAVE A HUGE STOCK OF CRIMP CONNECTORS FOR MANY COMMON COAX CABLES. PLEASE CHECK OUR WEB SITE OR CALL.

ROTATORS

Hygain, CD-45II	$429
Hygain, Ham-IV	$599
Hygain, Ham-V	$939
Hygain, T2X	$699
Hygain, T2X Digital	$1,159

ROTOR CABLE - US MADE

R62, 6-#18	$.59/FT.
R81, 2-#18/6-#22	$.49/FT.
R82, 2-#16/6-#18	$.79/FT.
R83, 2-#14/6-#18	$.89/FT.

STEEL MASTS

High-carbon steel masts. Typical yield strength of 83,000 PSI.

	.12"	.18"	.25"
5 FT.	$69	$79	$99
8 FT.	$109	$129	$159
10 FT.	$129	$149	$189
12 FT.	$159	$179	—
13 FT.	—	$199	$239
15 FT.	—	$229	—
18 FT.	—	—	$329
21 FT.	$269	$319	—
22 FT.	$279	—	—
23 FT.	—	$339	$429

ALUMINUM TUBING

Our 6063-T832 aluminum tubing is all American made to our exacting standards for the highest quality and precision.

O.D.	WALL	COST/FT.
6063-T832 DRAWN ALUMINUM TUBING		
.375"	.058"	$.65
.500"	.058"	$.70
.625"	.058"	$.80
.750"	.058"	$.90
.875"	.058"	$.95
1.000"	.058"	$1.00
1.125"	.058"	$1.10
1.250"	.058"	$1.30
1.375"	.058"	$1.40
1.500"	.058"	$1.50
1.625"	.058"	$1.65
1.750"	.058"	$1.80
1.875"	.058"	$1.95
2.000"	.058"	$2.10
2.125"	.058"	$2.25
6061-T6 EXT. AL. SQUARE TUBING		
.750"	.062"	$.95
1.000"	.062"	$1.25

TEXAS TOWERS

TOLL FREE **(800) 272-3467**

1108 Summit Avenue, #4 • Plano, TX 75074

Hours: M-F 9 AM-5 PM Central Time

Email: sales@texastowers.com

MASTERCARD VISA • DISCOVER

Proudly Serving Ham Operators Since 1978!

Visit Our Website for More Great Deals:

http://www.texastowers.com

RT Series Tuners

THE ACE UP YOUR SLEEVE

LDG ELECTRONICS

Our new house had everything: a nice big yard with some trees in the back, a bedroom for each kid, a two-car garage, and a den for the ham shack. I hated it; there's a Home Owner's Association. I submitted plans for a tower to the HOA, and they actually laughed at me. I invoked PRB-1; they countered with PR-We Don't Care. The word "litigation" hovered like a toxic cloud over the table.

I gave up, partly because I don't have money to waste on lawyers, but partly because I had an ace up my sleeve. A ground-mounted vertical back in the trees, a can of brown spray paint, a few ground rods, and I'd be in business. Yes, I've heard the one about how a vertical is an antenna that radiates equally poorly in all directions, but it was that or nothing. I knew without a radial field I'd need a tuner, and the one built into my transceiver wasn't going to cut it.

Any of LDG's automatic tuners would do the trick, but in a coax run that long SWR losses would be pretty high. LDG now has weatherproof tuners that mount right at the antenna, eliminating coax SWR losses. LDG's RT tuners are completely automatic, and are powered over the coax feedline; no separate power line is required. The RT-100 handles up to 100 watts, and the RT-600 up to 600 watts. The included remote control inserts 12 volts dc onto the coax, and lets you select the operating mode. It all works great; I just transmit and the RT-100 automatically tunes as needed. The rig just hums along into a perfectly matched all-band antenna, and it's the next best thing to invisible.

LDG's RT tuners will work with any coax fed antenna, or long wires and antennas fed with ladder line through a balun. Visit us on the web at www.ldgelectronics.com for more information, and for links to the fine dealers who sell LDG products.

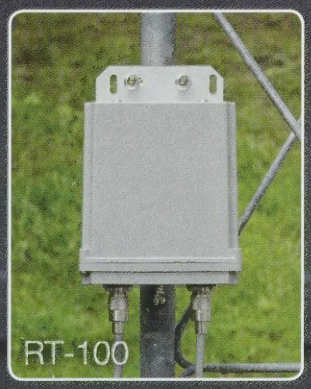
NEW! RT/RC Series Tuners & Control Units

A Technological Breakthrough In Remote Tuning!

Coax in / coax out tuner designed to be placed near the feedpoint of the antenna. Place the RT Series Tuner near the feedpoint and virtually eliminate all feed line loss due to SWR. DC powered over the coax, so use the RC Series Control Unit to power and control the tuner from your shack. The RC Series Conrol Unit will provide DC power over the coax as well as control for Auto mode, Lock, and Tune.

100 Watt
RT/RC-100 Suggested Price $249.99

600 Watt
RT/RC-600 Suggested Price $449.99


RT-100

RT-600

www.ldgelectronics.com **410-586-2177**

Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!

AIRWAVE SUPERIORITY

Never before has a compact HT offered as many features, and such high powered performance as the TH-F6A. Arm yourself with one today and gain your own airwave superiority.

- Triband (144/220/440 MHz)
- Receives 2 frequencies simultaneously even on the same band
- 0.1~1300MHz high-frequency range RX (B band)[1]
- FM/FM-W/FM-N/AM plus SSB/CW receive
- Bar antenna for receiving AM broadcasts
- Special weather channel RX mode
- 435 memory channels, multiple scan functions
- 7.4V 1550mAh lithium-ion battery (std.) for high output[2] and extended operation
- 16-key pad plus multi-scroll key for easy operation
- Built-in charging circuitry for battery recharge while the unit operates from a DC supply
- Tough construction: meets MIL-STD 810 C/D/E standards for resistance to vibration, shock, humidity and light rain
- Large frequency display for single-band use
- Automatic simplex checker
- Wireless remote control function
- Battery indicator • Internal VOX • MCP software

[1]Note that certain frequencies are unavailable. [2]5W output

TH-F6A
TRIBANDER

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#43314